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A NEW RAY LAMP.

The new form of ray lamp which we describe in another column has an interest aside from its construction, from the fact that experiments conducted with it would appear to disprove the theory that a glass vacuum envelope plays a significant part in the generation of Röntgen rays. This theory, which was advanced by Dr. Röntgen himself, has been strongly supported by Poincaré and provisionally accepted by other authorities. Yet Prof. Woodward has obtained excellent shadowgraphs from the radiations passing through the sides of the aluminum cone of his lamp. This supports another theory that has been offered, to the effect that Röntgen and cathode rays are independently generated in a vacuum tube, but that the former alone have the power of traversing the glass envelope. The fact that clearly defined radiographs of the hand were taken in five seconds shows that Röntgen vibrations are very greatly weakened in passing through the glass of the ordinary vacuum tube; this, however, was to be expected in view of the opacity of glass to such rays as indicated in radiographs. Should further experiments confirm the results thus far obtained, Prof. Woodward will have the honor of having contributed the first important extension to the work of Röntgen. It is remarkable that with the entire scientific world engaged in investigation, with the exception of the Harvard experiments to which we refer, not a single addition has been made to the facts set forth by Prof. Röntgen in his remarkable paper, beyond adding a few more substances to his list of those opaque or transparent to the new rays.

RONTGEN RAYS.

Though the newspaper press during the past week has continued to report new discoveries concerning Röntgen phenomena, these have consisted either of mere repetitions of what had been originally announced in Prof. Röntgen's great paper, or of previously known phenomena having no relation to Prof. Röntgen's discovery. Among the latter may be mentioned dark photography and obtaining an image of an object on a sensitized plate when the plate and object are within an oscillatory electrostatic field. In even some cases a great discovery has been heralded, though based merely upon an image of a coin or other object having been obtained by passing an electric discharge through the latter when resting on the film of a sensitized plate, or merely separated from it by a piece of cardboard. Much stress has also been laid on obtaining photographs by sunlight or by means of ordinary sources of artificial illumination through plate-holder slides, cardboard and other thin coverings over photographic films. Light rays will travel, though in very small quantities, through an appreciable thickness of almost any organic substance if the exposure is sufficiently lengthy; on the other hand, the quantity of light necessary to affect some sensitive films is extremely small. Many will recall reading about 10 years ago or more an account of the experiments with dark photography made in the Alps by a German professor, during which he obtained a clearly defined photograph of Mt. Blanc on a midnight of pitch darkness. Some of the professors are not entirely free of guilt with respect to parts of misinformation now being spread before the public concerning Röntgen phenomena, particularly with reference to reports of "new discoveries"—already pointed out in Röntgen's paper—or experiments that are mere repetitions of others made in Europe, and it is difficult to see what is to be gained by a notoriety thus achieved. Of the two names offered to designate Röntgen prints, that of *radiograph* has been considerably em-

ployed from the beginning in Europe, while *scotograph* appears to meet with some favor on this side of the water, though the first-named was early adopted by some of our investigators. Owing to Prof. Röntgen having in his paper applied the term "X-rays" to his discovery, lay writers have taken the modest savant at his word and continue the use of the term, though improperly. While the use of this designation may be accorded as a privilege to the discoverer himself, to others "Röntgen rays" is, according to the etiquette of science, the more appropriate name, and, besides, should be employed as a tribute to the discoverer of one of the most startling phenomena with which man has ever been made acquainted, and one which promises most remarkable developments for the future, both in the domain of practice and that of pure science.

STANDARD ELECTRICAL RULES.

In another column will be found a list of the professional and other organizations that are to be represented at a meeting to be held in New York City next month for the purpose of preparing a code of rules for the safe construction and operation of electrical plants. The delegates appointed by the various organizations, whose names also appear in the list, will form a body of high authority, and the result of their deliberations should be a code of rules superior to any now in existence. The formulation and promulgation of such a code, however, will lead to little or nothing if it does not receive the recognition of the insurance interests of the country. Should such recognition be withheld, the code will have little more than an academic interest, for the power of underwriters to prescribe what rules shall be followed in the installation and operation of electrical installations is absolute. No owner will, with the certainty before him of otherwise having the insurance on his property removed, permit work to be done in violation of underwriters' rules; on the other hand, few contractors will be inclined to follow rules differing from though not violating, the requirements of the insurance rules to which their work is subject if any extra expense is thereby entailed. The formulation of a code of rules such as is proposed is, therefore, but the first and easiest step; securing its general adoption by underwriters may be a matter of far greater difficulty. This latter consideration should not for an instant be lost sight of, for should such recognition of the proposed code be refused, its existence, rather than being desirable, might prove the reverse by again stirring up a strife between antagonistic interests, which, thanks to the almost exclusive use at present of the rules, in whole or in part, of the Underwriters' National Electric Association, has during the past several years greatly subsided. We note, by the way, that the body just named is not represented among the organizations invited to participate in the preparation of the proposed code. Why it should have been refused recognition would seem, in view of the public nature of the object to be attained, to demand explanation. The body is a national organization similar to many of those represented in the list we print; during the three years or more it has been in existence, the systematic study of the requirements for the safe construction and operation of electrical installations has been an object uninterruptedly pursued, and rules formulated in accordance with the conclusions arrived at have exhibited a creditable spirit of fairness toward the industries affected; as far as we know, its code has not been subjected to adverse criticism as a whole, and is now in general use throughout the United States. But few of the bodies to be represented in the joint conference could speak with greater authority from the insurance point of view as to the requirements to be observed in the formulation of a code of rules such as proposed; and—what is more important—its members in their character of electrical experts to the more important underwriters' associations throughout the country, will wield the greatest influence for or against the adoption of the code for insurance purposes. As favorable action by the insurance interests on the proposed rules would not only destroy their own work of years but also, should their organization not be represented, discredit them personally, it would not be surprising in the latter event if their influence should prove adverse. The general adoption by the insurance interest of the code to be prepared next month by such a competent body of experts would be a great boon to the other interests affected, and it, therefore, seems unfortunate that the complication to which we have referred should have been introduced in the preliminary stage. It is not yet too late, however, to retrieve what cannot be considered otherwise than as an error. Since the delegates of the several organizations to be represented at the joint conference have a direct interest in any question affecting the outcome of their labors, this is a matter which might well form the subject of action on their part.

The Chicago Electrical Association.

The following is the programme of the Chicago Electrical Association for the Spring season:

March 6, "Twenty Years' Progress in Telephony," by S. G. McMeen; March 20, "The Gas Engine and Its Electrical Applications," by Chas. McDonald; April 3, "The Commercial Testing of Iron and Steel," by W. K. Howe; April 17, "Little Economies in Central-Station Practice," by T. G. Grier; May 1, "Problems in Electric Elevator Work," by H. Cochrane; May 15, "Electric Heating," by Edward Puchta; May 29, banquet and social evening.

The officers of the association for 1896 are: W. Clyde Jones, president; S. G. McMeen, vice-president; F. S. Hickok, treasurer; J. R. Cravath, secretary; Albert Scheible, F. A. Muschenheim and W. R. Garton, directors.

The New York Electrical Society.

The next meeting of the New York Electrical Society will be held at the Duane Street Edison station (57 Duane Street) on Thursday, Feb. 27, at 8 p. m. On that occasion Mr. Jno. W. Lieb, Jr., president of the society, will deliver an address on "The Generation and Distribution of Current by an Edison Station." By the courtesy of the Edison Electric Illuminating Company, the station will be thrown open for the inspection of the visitors.

The New York Electrical Society was organized in 1881, thus antedating the American Institute of Electrical Engineers by three years. While local in its scope, in the character of the papers read and the standing of the writers who have contributed to its proceedings this flourishing society compares very favorably with the national body. The programme for the current season comprises 10 papers, most of which would, if contributed to electrical literature, do credit to the transactions of the Institute, and all are on subjects of timely or general interest and by competent writers. Unless the Institute bestirs itself and makes an endeavor to procure papers for its stated meetings, instead of allowing them to lapse or made merely the occasion for the discussion of papers read at prior meetings, the competition of this vigorous society may make sad inroads among the local membership of the national body.

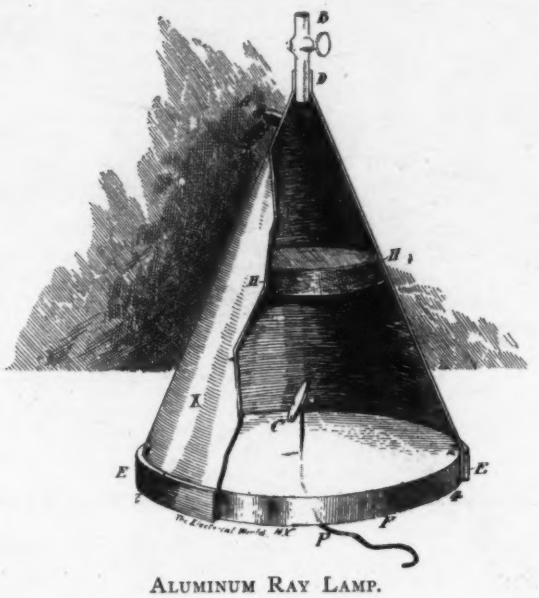
Incandescent Gaslight Mantles.

Referring to a recent decision of the German Patent Office in connection with the Welsbach patent for the mantle of incandescent gas lights, the *Engineering and Mining Journal* says that the novelty of the use of an incandescent mantle has been denied and the denial has been sustained. While not annulling the entire patent, the fact of impregnating with salts a fibrous material made into the shape required was proved to have been anticipated by Williams in England and Khotinsky in America. The experts also exclude the use of magnesia from the patent, so that nothing remains except the use of certain mixtures of mineral salts. This field our contemporary believes to be a wide one, as many of these mixtures have not and cannot be patented; therefore, it would appear that practically anybody can make these mantles with impunity. Another point which is quite important has been raised; *i. e.*, whether the Welsbach mantles are made according to specifications, so that the industry is doubly free. In all disputes so far the Welsbach people have relied to a large extent on their claim to mantles in general and have not laid particular stress on the salts. In England there are to-day, at least, about six competitors of the Welsbach company openly doing business, and none of them is sued by the Welsbach company, and after this decision by the German Patent Office it is not likely that they will feel very nervous.

A New Form of Ray Lamp.

We illustrate herewith a new form of ray lamp devised by Prof. Woodward, of Harvard University, by means of which excellent radiographs have been obtained. As the sides of the lamp permit cathode rays to pass through them, the fact that with it radiographs may be obtained contradicts the theory that a glass envelope plays an essential part in the generation of Röntgen rays.

From the diagram it will be seen that this new form of ray lamp is that of a cone, and its characteristic difference from the ordinary Crookes tube is that the sides or walls of the lamp, *H H*, are made of sheet aluminum, $\frac{1}{32}$ inch in thickness; the base of the lamp, 1, 2, 3, 4, is of solid glass, practically a plug fitted into the base of the aluminum cone with plaster-of-Paris, and made air tight. A metallic ring passes around the base of the cone at *E E*, and holds the sides of the cone firmly to the glass bottom. Through a point, *F*, a little to the side of the centre of the glass base,



ALUMINUM RAY LAMP.

passes the cathode pole into the lamp, and at the end of this is fastened a platinum disc, at such an angle as to be parallel with the side of the lamp at the point *X*. At the top of the lamp, and directly connected to the metallic side, is the anode pole *A*, and at the top of the cone is a glass tube with a stop-cock, so that the air may be exhausted. This glass tube is also fastened in with plaster-of-Paris and bound by a metallic ring. A circular wooden disc is fastened on the inside of the metallic cone at *H H*, to prevent any collapse of the sides on exhaustion. By this construction it has been found that the difficulty from the absorptive power of the rays by the glass of the Crookes tube has been eliminated in a most marked degree.

As yet, Mr. Woodward has worked with this lamp with induced currents of between 25,000 to 30,000 volts, and with such very clearly defined radiographs of the hand have been taken in five seconds.

It seems from this that with more experimental work, and a higher current, say, 50,000 volts, that an instantaneous photograph may be taken, and the heavier parts of the body readily photographed.

Philadelphia Electric Lighting Companies.

It is reported that the Pennsylvania Light, Heat & Power Company has made an arrangement whereby it will obtain absolute control of the Edison Electric Illuminating Company, of that city. The directors of the former company have agreed to purchase all the stock of the Edison Company offered at $150 per share, $50 to be paid in cash, and $100 in 5 per cent. 50-year collateral trust gold bonds. There are 20,000 shares of the Edison stock, and it is thought by the directors of the Pennsylvania Company that they will be able to secure almost the entire amount. It is said that the capacity of the Edison station is then to be doubled without buying additional machinery, by the addition of a large storage-battery plant. The preferred stock of the Pennsylvania Company amounts to $5,000,000, on which it is claimed more than $800,000 have been paid up.

Mayor Warwick last week vetoed a bill passed in the interests of the Pennsylvania Electric Light, Heat & Power Company, permitting electric light companies to lease conduits of other companies having underground privileges. One of the grounds given for the veto was that the principal object to be accomplished by the ordinance is to permit the consolidation of two corporations, thus depriving the public of the benefits of competition. The veto was sustained by the Common Council.

A Westinghouse-General Electric Rumor.

The report is again current in Pittsburg and New York that negotiations are under way between the Westinghouse and General Electric Companies with a view to a division of territory and pooling of arrangements. The reported equipment of the New York City elevated roads at a cost of $8,000,000, has, it is said, led to the opening of the negotiations, the purpose being stated to be to reach an amicable agreement in regard to the division of this contract. Mr. Westinghouse and other officers of his company deny that there is any truth in the rumor.

The Texas Street Railway Association.

The Texas Street Railway Association will hold its second annual convention at Galveston on March 18 next. The officers of the association are: W. H. Sinclair, president, Galveston, Tex., and C. L. Wakefield, secretary, Dallas, Tex. These, with W. H. Weiss, of San Antonio, Geo. F. Hendricks, of Fort Worth, and C. A. McKinney, of Houston, represent the directory. Supply men will be welcome, and space will be provided for them for exhibits if they so desire. Applications for space should be made to J. K. Urie, Galveston City Railway Company, Galveston, Tex.

Röntgen Rays.

In the *Revue Generale des Sciences* of Jan. 30, M. Henri Poincaré, the eminent French mathematical physicist, discusses the subject of Röntgen rays. Prof. Röntgen, he says, first discovered the rays bearing his name, when one day he enveloped a Crookes tube in which cathode rays were being produced, with black cardboard, and after having placed the tube in a dark place, approached a sheet of paper covered with platino-cyanide of barium. The paper became fluorescent, the effect persisting at a distance of over six feet. He immediately appreciated the extraordinary significance of the discovery, and at once began to investigate the effect on photographic films.

M. Poincaré states that the opacity of bodies to the rays increases with the density, but at a much greater rate than increase of density. He refers to a radiograph accompanying the article, which very plainly shows the heterogeneity of a piece of zinc. In regard to the properties of the rays, he enumerates them as follows:

1. They are radiations, as shown by the well-defined shadows cast by bodies relatively opaque, and their propagation is thus rectilinear. 2. They are not luminous rays, due to transverse vibrations of the ether. Such radiations can give rise to the most diverse manifestations, and range from Hertzian rays through ultra-red or calorific rays, visible rays, to ultra-violet or chemical rays. Notwithstanding this diversity of effect, however, there is in reality no more difference between Hertzian rays and visible rays than between red light and green light. What, then, is to prevent, in order to explain the new phenomena, from adding another step to this scale? Do not certain ultra-violet rays traverse silver, which is opaque to ordinary radiations? Has not invisible photography itself been realized to a certain extent in recent years? The answer is, that Röntgen rays are not refracted; they are not reflected, or at least not regularly. These are their remarkable properties, which distinguish them absolutely from transverse waves; these latter, in fact, from Hertzian to ultra-violet waves are refrangible, and their refrangibility increases in a regular manner, as the length of the wave diminishes. 3. The rays are not cathodic. It is known that cathode rays travel through aluminum, as shown by Lenard, but they are diffused in the atmosphere and cannot proceed beyond a few centimetres. Röntgen rays, on the contrary, have affected plates at a greater distance than a metre. Besides, cathode rays are incapable of traversing but a few bodies, and, finally, Röntgen rays cannot be deviated from their course by a magnet. 4. Röntgen has thus been led to ask if his rays are not longitudinal vibrations of the ether. This is thus far a mere hypothesis, as experiments in interference, which alone can prove it, are almost impossible with waves which travel in a straight line, and nothing can deviate them, neither refraction nor a magnet. However this may be, we are in the presence of a new agent, as new as was electricity in the time of Gilbert, and galvanism in the time of Volta.

As to the origin of the rays several hypotheses may be offered. It can be supposed that the cathode emits, beside the ordinary cathode rays, other radiations which, possessed of different properties, travel through the glass of a tube and propagate themselves in the atmosphere. This hypothesis is dismissed with the statement that ordinary cathode rays strike the wall of a tube, which becomes fluorescent and in turn forms a new centre of radiation; the radiations proceeding from this centre are partly transverse waves visible to the eye, and partly Röntgen waves. The study of the shadows proves this; besides, if a magnet is approached, the cathode rays in the tube are displaced and with them the centre of emission of the Röntgen rays. Therefore, it is the glass which emits the Röntgen rays, and it does so in becoming fluorescent. Is it not possible that any body sufficiently fluorescent will emit the new rays, whatever the cause of the fluorescence? The phenomena would then not be bound to an electrical origin. This is pronounced not very probable, but easy of verification.

In conclusion, he says that as the luminous source is not the cathode but the fluorescent surface of the glass tube, the source is comparable to a luminous sphere of considerable diameter, and a small object therefore projects behind it an umbral cone, surrounded by a penumbra. The cathode, therefore, should be given the form of a concave spherical mirror, having its centre near but not on the glass wall (in the latter case the glass might be broken). The most intense part of the source will thereby be reduced in extent. An object larger than the source should be approached to the source and removed further from the plate; if the object is small it should be placed as near as possible to the plate, but not too near the source.

A portion of the article of M. Poincaré consists of a digression attacking the theory that cathode rays are longitudinal vibrations.

In the same journal M. Perrin, of l'Ecole Normale Supérieure,

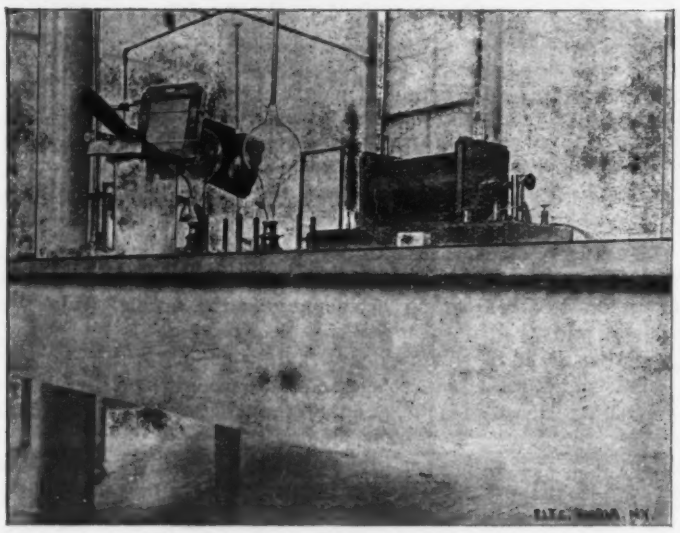


Fig. 1.

gives an account of some experimental researches with Röntgen rays, made with a view to finding evidences of refraction and reflection, but no traces of such properties were discovered. Another conclusion is that if the phenomenon is periodic, the period is inferior to that of light, and that it is even possible that there is no periodicity. The experiments described are spoken of as verifying rigorously that Röntgen rays are propagated rectilinearly.

Prof. Daniel W. Hering, of the University of the City of New York, has been very successful in obtaining some very fine radiographs, several reproductions of which we print herewith. Fig. 1 shows a photograph of the apparatus used, taken during its operation. Three plate holders are seen arranged around a globular Crookes tube. The tube was excited by an induction coil giving a spark of about three inches; the primary current is obtained from a storage battery of six cells of the chloride type. The exposures of plates varied from one hour to two hours and thirty minutes. Fig. 2 exhibits the bones of a frog and other objects, and also the shadow of a spiral wire of aluminum one thirty-second of an inch thick. From the opacity of this latter it is remarked that aluminum can only be said to be transparent to Röntgen rays when very thin, or when the rays are very intense. Fig. 3 shows a pocket-knife and chalk crayon, both opaque; a dropper, both rubber cap and glass slightly transparent, and the carbon pencil of a small arc lamp, which is seen to be more transparent than the glass.

Fig. 4 is reproduced from an illustration in the French journal *La Nature*.

Prof. Arthur W. Goodspeed, in a paper read before the American Philosophical Society in Philadelphia on Feb. 20, gave the following data of the apparatus with which he has made experiments at the University laboratory: A storage battery of eight cells; an App induction coil with a resistance in the primary of .3 of an ohm, and 3200 ohms in the secondary coil; and a vacuum tube about eight inches long. Among experiments made to illustrate the paper was one showing how the rays can be utilized for discovering flaws in metal. Three plates of metal about one quarter of an inch thick were used; in one were holes of different shapes and sizes; the surface of another had been stamped with a die and the third was a perfect plate. The prints very plainly showed the stamp marks. Dr. Goodspeed related that in the Fall of 1889 Mr. W. N. Jen-

Fig. 2.

nings while photographing the brush discharge of a large induction-coil obtained a shadow print of a couple of coins that had been laid upon a plate holder near the coil.

At the same meeting a paper was read by Mr. J. F. Sachse, in which he called attention to the fact that in the very room in which the meeting was sitting, a discussion took place on April 29, 1843, on

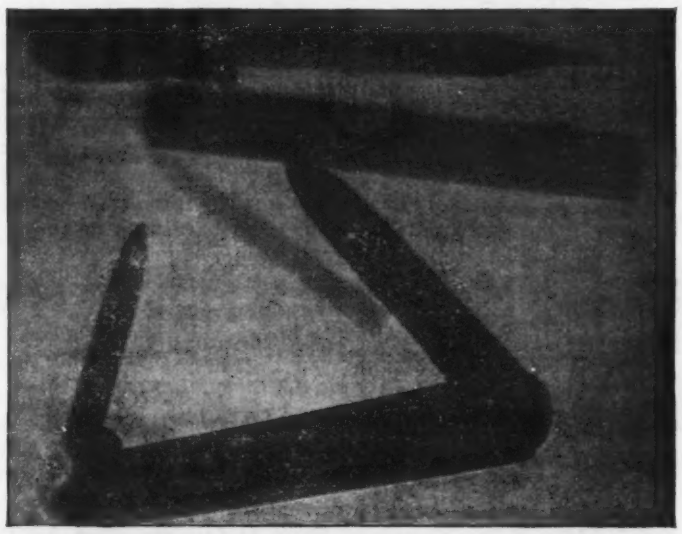


Fig. 3.

Morse's theory of invisible photographic rays, which was partici pated in by Prof. Henry and others.

In a letter to the London *Electrical Review*, Mr. A. A. C. Swinton says that it is not necessary to employ a high-frequency coil to take radiographs by the Röntgen method. Any ordinary Ruhmkorff coil capable of making at least a three-inch spark in air, or, better, a four or five inch spark, will do if connected to a sufficiently exhausted vacuum tube of the proper size. He thinks it would be better to work a Ruhmkorff coil with primary or secondary cells instead of with an alternating current.

Prof. Borgmann, of the St. Petersburg University, has telegraphed to the London *Electrician* the information that he discovered that Röntgen rays discharge positive electricity rapidly and negative electricity more slowly; that at short distances such rays cause negative electrification, and that they increase the spark gap. Commenting upon this editorially, the interest of Prof. Borgmann's experiments is stated to lie in his discovery that Röntgen rays, like cathode rays, negatively electrify bodies; that, like Hertzian waves, they increase the sparking distance for a given potential difference; and that they discharge positive electrified bodies more quickly than they do negatively electrified bodies, which latter statement, however, is declared to be directly contrary to the results of experiments by MM. Benoist and Hurmuzescu.

Prof. Harding, of Washington, D. C., has proposed an instrument, which he calls a "scotoscope," for observing Röntgen shadows direct with the eye. A sheet of gold leaf shellaced to a thin plate of vulcanite is made to form one side of a box, a plate of glass the other side. The gold surface is to be inside and the air must be pumped out to form a vacuum. "If this is held behind the object penetrated by the Röntgen rays, most all the energy that strikes the gold leaf is turned to light and we can plainly see all the shadows cast by bones, bullets, needles, etc. The hand, for instance, held near the fluorescent plate can be moved and turned so as to apply the illuminant to any part." "I hold that the light in the scotoscope can be reflected and refracted and focused by a lens; that this light so produced is strongly actinic and is the only means by which to reduce pictures to a small size and having them fixed by direct vision they can be studied under the microscope. The vital difference and the value of the discovery is that we obtain by this means not shadows of shadows but pictures direct from the objects." It does not appear that Prof. Harding has made such an instrument.

FIG. 4.

At the Illinois Steel Works experiments were made to determine if flaws in castings can be detected by means of Röntgen rays, and, according to a press despatch, defects that would otherwise have escaped notice were revealed.

Among the claimants for the prior discovery of shadowgraphy are Mr. A. L. Bogart and Mr. Nikola Tesla. According to the New York *Times*, the former had, by means of ordinary light, taken shadow prints of objects with a quarter inch board between the latter and a photographic plate. A reporter, who visited Mr. Tesla's laboratory, writes as follows:

"It is a remarkable fact that not to Röntgen nor to any of the recent experimenters is the credit of discovering the penetrative power of the X ray due. Its development, like that of most great discoveries, has been gradual and has proceeded by a regular process of evolution, in which many men of science have taken part. Mr. Tesla himself made public several years ago the fact that when there were sudden discharges of electricity through a wire, certain waves, which he designated 'sound waves of electrified air,' were propagated; or, as he himself explained it, 'certain kinds of waves which I called 'sound waves of electrified air' are propagated from conductors when a strong rapidly vibrating current passes through them, such as sudden discharges from condensers. These propagate in straight lines like sound. They are longitudinal waves, penetrating bodies; they cannot be stopped by interposing metal plates."

The reporter adds, however, that Mr. Tesla does not know if his "sound waves of electrified air" are similar to cathode rays or different from them, and credit is given to Lenard for prior work. "Another fact," he says, "will be remembered and accorded to the credit of Mr. Tesla—that all the discoveries made through the popularization of the Röntgen experiments were made possible by a remarkable invention of Mr. Tesla—his converter. For, whether credit is given to Mr. Tesla in the reports of experiments or whether he is ignored or slighted by the mention of 'a converter' used in the process, the Tesla converter is used universally to obtain the sudden discharges of electricity through which the X ray is produced. 'If every one who uses my machine in electrotheraphy alone would give me a quarter I would be a very wealthy man,' Mr. Tesla said with an ingenuous smile when I asked him what return beyond the fame of his achievement he had received. 'It is used now by millions of persons, but I have never received a dollar from it, and there is no way in which I could.'

"A curious fact about Mr. Tesla," says the reporter, "which is recalled by the recent experiments with the cathode rays, is the fact that he demonstrated first the possibility of taking photographs with those rays. He took photographs of Joe Jefferson, Mark Twain and others by their light, and these photographs were reproduced to illustrate a story about his workshop. But the experiments made then did not possess the quality of popularity as did the Röntgen experiments, or, in fact, the earlier experiments of Mr. Tesla himself."

A Philadelphia newspaper reports that among the radiographs taken by Profs. Goodspeed and Cattell, of the University of Pennsylvania, are: Hands of a cadaver, showing two bullets and a piece of glass embedded in the palms; pieces of rib covered with cirrhotic liver one centimetre thick; small intestine containing a cent, lead pencil and gall stone; six pins in the centre of a section of liver one centimetre thick, and blade of penknife covered by two and three-fourths centimetres of lung tissue.

Drs. Oudin and Barthélmy, of Paris, have succeeded in obtaining a radiograph of the arm of a six-months still-born child. The bones, yet unformed and unjoined, stand out darker than the surrounding tissues. The study of the progress of ossification in the unborn child, which had heretofore proved so difficult and tedious in the ordinary study of anatomy, is thus singularly simplified.

In the laboratory of Columbia College last week Prof. Pupin took two pictures with the aid of Röntgen rays of the hand of a Wall Street lawyer who accidentally received a charge of shot in his hand a month or so ago. The picture ranked with the best taken by Prof. Pupin, for there was no trace of the flesh on the plate, and but a suggestion of the bones in faint shadows, while the shot stood out plainly and sharply in, as well as around, the bones. The lawyer took the plates to his surgeon to aid him in his work of digging out the shot, so that the crippled hand might again be used.

As the chemical, barium platino cyanide, used by Prof. Röntgen in some of his remarkable experiments, is not usually kept in stock by chemists, it may be of advantage to our readers to know that it is manufactured by Baker & Co., platinum refiners, of Newark, N. J.

Some Theories.

In a report in the columns of the Philadelphia *Ledger* on the discussion of a paper on Röntgen rays, read before the Franklin Institute, Prof. M. B. Snyder is quoted as saying that his idea was that the Röntgen ray vibrations were transverse; he had no doubt about it. Longitudinal vibrations must be reserved for gravitational action. If they were longitudinal, they must be of infinite velocity. There is nothing, he said, in the Röntgen ray differing from what we call an electromagnetic ray. In time it will be possible to refract and reflect it and do anything with it that we can with light. Possibly what we term light in our atmosphere is nothing more than a transformation of energy out of the cathode rays shot off by the sun itself. Possibly light does not come from the sun at all. He believed that the vibrations known as light were generated in the atmosphere. The rays known as light, heat, electric, etc., were but various transformations that take place in the atmosphere. Were we to go up beyond the atmosphere we would not see the sun at all. The light is generated here, and we have eyes made to take up these vibrations and make them visible.

Electric Coal-Cutting by Contract.

According to the *Engineering and Mining Journal*, a company has been incorporated in England whose business it is to cut coal for different mines at a prearranged price, putting in the whole installation at its own cost; it has not yet reached a paying basis, but is doing good work.

Central Station Working.—X.

A Method of Calculating the Cost of Furnishing Electric Current and a Way of Selling It.

BY W. J. GREENE.

A MANAGER of a central station has, directly or indirectly, two objects in view—the increasing of the revenue, and the decreasing of the expenses. A thorough knowledge of the cost of supplying current, and of the rates at which it should be sold, would naturally come under the first head, and is of great importance in insuring the permanent success of a lighting plant. The experience of the writer's own company on these features, and data formulated therefrom, may prove of some interest.

In January, 1888, the company commenced the supply of current for light, using the alternating-current system. In the Fall of 1888 a few meters were installed, and in the Spring of 1889 the use of meters was adopted exclusively, except for one or two lamps. The rate charged was one cent per ampere-hour on 50-volt current, regardless of the amount consumed. Lights were added very rapidly. The stockholders were continually called upon to provide means for enlargements to the station equipment, extensions to the circuits and purchases of converters and meters. The net earnings for a time increased in proportion to the increase in investments. In 1892, however, a very apparent falling off in the net earnings in proportion to the new capital invested was noticed. It became evident that something was wrong. Tables were therefore prepared, showing the expense of maintaining an equipment necessary to supply current for consumers having from one light and upward. In comparing these results with the actual receipts from the various consumers, it was found that only 25 per cent. of residence consumers and 55 per cent. of other classes used sufficient current to furnish a paying investment. A few years prior thereto fully 85 per cent. of residence consumers and 95 per cent. of other classes were considered profitable. To find that too much business was undermining the stability of the company and jeopardizing its success was startling. It was evident that radical changes in the method of selling current must be made. Various plans, suggested by the practice of different companies, were considered, and it was finally decided to adopt the custom, more or less prevalent, of making a minimum charge; the charge to be a sufficient amount to cover all expenses known to be incurred in adding a consumer. In these expenses interest on the investment and an amount to cover depreciation due to wear and tear, which would not show up in repairs during the earlier life of the plant, were included.

To determine the least amount for which the company can afford to accept consumers it is necessary to establish how changes in the equipment, consumers, or consumption of current affect the expenses. I have made the following groups which I think are reasonably correct:

First. Expenses affected by the equipment, from real estate to meters, and expressed by the relation of the maximum number of lights burned at one time during the year to the investment.

Second. Expenses affected by the number of consumers.

Third. Expenses affected by the amount of work done by engines, boilers, dynamos, etc., and shown by the output in watt-hours.

Fourth. Expenses practically unvarying, and practically independent of the size of the plant, the number of consumers or the amount of current supplied. These may be considered as the basic expenses, or the starting point at which expenses begin to increase more or less in proportion to any increase in the size of the plant, the number of consumers, or the amount of current generated. They are necessarily estimated expenses, and cover the cost of running the station with a unit suitable to provide for the day load, supplying current to the switchboard only. The company must depend on long-hour consumers to furnish necessary revenue to meet these expenses. This fourth group is divided into three classes—those dependent on capital invested in the day unit, those dependent on the management of such a unit without any consumers, and those dependent on the power necessary to maintain the potential at the switchboard.

Fifth. Expenses affected by the size of the meter required by the individual consumer. The meters are treated separately, because the size of the meters are not always proportional to the number of lamps installed.

The first group comprises, in our classification of accounts, such expenses as total charges, exclusive of meters, for interest, depreciation, taxes, insurance, engineers and helpers, building repairs, switchboard repairs, station wiring repairs, tool and instrument repairs, circuit repairs, converter repairs, and service line repairs.

The second group comprises total charges for management, clerical service, stationery and printing, general expenses, petty repairs, rents, office heating and lighting, furniture and fixture repairs and reading meters.

The third group comprises total charges for water, fuel, firemen and helpers, oil and waste, boiler compounds, boiler repairs, pump repairs, breeching repairs, piping repairs, engine repairs, shafting and pulley repairs, belting repairs and dynamo repairs.

The fourth group comprises:

First. Two engineers at nominal wages, interest, depreciation, taxes, insurance, building repairs, switchboard repairs, station wiring repairs and tools and instruments repairs, on the capital invested in the smallest unit suitable for supplying current for the day load.

Second. An estimated amount from charges in the second group, and intended to be an amount below which it might be considered such expenses could not be reduced, even if the plant were operated without a consumer.

Third. Two firemen, water, fuel, oil and waste, boiler compound, boiler repairs, pump repairs, breeching repairs, engine repairs, shafting and pulley repairs, belting repairs and dynamo repairs, necessary to keep the potential at the switchboard when running the smallest unit 24 hours per day.

The fifth group comprises: Interest, depreciation, taxes, insurance and repairs on meters, figured on the size of meter necessary for any desired number of lamps.

For simplicity, the following letters are used to represent the factors employed in these calculations:

F — the first group.
C — the second group.
W — the third group.
f — the first division under the fourth group.
c — the second division under the fourth group.
w — the third division under the fourth group.
M — the fifth group.
L — the maximum number of 16-cp lamps burned at one time during the year.
l — the number of lamps in any consumer's installation for which the cost is desired.
e — the energy consumed per 16-cp lamp in watts.
N — the number of consumers.
T — the total annual output in kw-hours measured at station switchboard.
P — the percentage of T lost in converter and line leakage.
$1 - P$ — the percentage of T used by consumers and lost in transmission, except that due to converter and line leakage, as provided for in P.
V — the efficiency of transmission, being the loss in conductors and converters, due to current used by consumers.
$VT(1 - P)$ — the amount of current registered by consumers' metres.
X — the minimum cost for which current can be supplied for l lamps.
Y — the cost for l lamps, above which the company can afford to make concessions.

Then:

(1) $\frac{l\,(F-f)}{L}$ = the annual cost of the F-f expenses for an installation of l lamps.

(2) $\frac{l\,P\,(W-w)}{L}$ = the annual cost of the W-w expenses for an installation of l lamps.

(3) $\frac{C-c}{N}$ = the cost of the C-c expenses per consumer.

(4) $\frac{L\,(F-f)}{L} + \frac{l\,P\,(W-w)}{L} + \frac{C-c}{N} + M =$ The least annual amount for which a company can afford to accept a consumer, if he uses no current at all. To this amount must be added the cost of the W-w expenses for a quantity of current, which at one cent per ampere-hour will equal the (4) expenses plus the W-w expenses for the above quantity of current. This is found by dividing (4) by one minus the W-w expenses per ampere-hour.

(5) $\frac{(W-w)\times(l-P)}{\frac{VT\times(l-P)}{e}}$ = the $(W-w)$ expenses per lamp-hour, expressed in decimals of one cent.

Hence:

(6)
$$X = \frac{\frac{l\,(F-f) + l\,P\,(W-w)}{L} + \frac{C-c}{N} + M}{1 - \frac{(W-w)}{TV}\,\frac{e}{}}$$

For residence lighting I give l a value of 3 for 5 lamps, 4 for 10 lamps, 5 for 15 lamps, 6 for 20 lamps, etc.; because, if such a consumer wishes to have provision made for a maximum of say, 20 lights, there would seldom be over six in use at one time unless an entertainment were taking place, in which case other places could be

counted on to cut off enough lamps to make up for the difference between the estimated maximum and the agreed maximum. For the value of Y, I add to the interest account an allowance for profits, and to the depreciation account an allowance to provide for depreciation, due to the dropping in value of apparatus and improvements in the same, which may necessitate a remodeling of a plant before the original machinery is worn out. The estimated expenses of f, c and w are made zero, and thus all expenses are provided for. A factor Z is introduced to allow for the following:

If the maximum load would average, say four hours each and every day, the allowance would not be necessary, because every light contracted for as a burning light, could then be relied upon to earn sufficient to pay its proportion of all expenses. The minimum charge could then be made the same as the charge above from which discounts could be made. Few plants, however, can show a four-hour maximum peak, and the conditions of operation must be met by dividing the expenses not included in the minimum charge, among the longer hour consumers. I endeavor to accomplish this and arrive at the value of Z by dividing the average maximum four-hour load in December by the average maximum four-hour load in July.

Hence:

$$(7) \qquad Y=Z\left\{\frac{\frac{l\,F+1\,P\,W}{L}+\frac{C}{N}+M}{1-\frac{We}{TV}}\right\}$$

For a direct-current plant, P would be so small that the W expenses in the numerator could be omitted in the expressions for both X and Y.

By putting the proper expense account under F, C and W, and letting l and L refer to arc lamps or motors, rated in watts or horse-power, the formula would be equally applicable to arc light or power service. e would be energy in watts per arc lamp, or watts allowed per unit adopted in motor service.

The above reasoning or formulas may not be absolutely without error or faultless, but I believe that they are, on the whole, fairly correct, and the information to be obtained therefrom I find very valuable, especially in competing for long-hour consumers. Data from various stations, showing the expenses per lamp, made up of expenses that vary with the number of burning lamps; the expenses per consumer, made up of expenses that vary with the number of consumers; the expenses per kw-hour, made up of expenses that vary with the station output; and the percentage of the output lost in converter and line leakage, would surely be as beneficial to managers as the collection of data showing the watts per pound of coal.

Tables made showing the values of X for different installations of l lamps, give the minimum charge; and similar tables for Y give the charges above which a company can afford to make concessions.

The following, from our form of contract, will give the method of selling current adopted by our company:

First is a statement showing the number and size of lamps:

(1) "Of which the subscriber agrees to burn not more than ———— lamps of 16 candle-power, or equivalent, at any one time.

(2) "The subscriber agrees to use current during the term of ———— year from the time connection is made, and pay therefore on or before the 10th day of each month at the rate of one cent per ampere-hour on 50-volt current, or two cents per ampere hour on 100-volt current, as may be shown by statement of the meter.

(3) "The subscriber further agrees that the minimum amount to be paid for current, and the use of the company's apparatus, other than a meter of the ordinary size, under this application and contract, shall be $—— per year, averaging $—— per month, and the company may at its option, render and collect the minimum bill each month, in which case, during those months of the year when more light is required and consumed by him than the minimum bill, the subscriber will be credited upon his monthly bills by such an amount as will equalize any sum paid in excess of the amount computed from the meter reading, providing, however, that he has paid the minimum amount of this contract pro-rated up to such a date."

For consumers who are entitled to concessions, the following is submitted for the third clause:

"In consideration of the reduced rates herein provided, the subscriber hereby agrees that the minimum amount to be paid for current in any month shall be.....dollars.

"The company agrees to make discounts on bills paid before the 10th day of each month as follows:

On bill of	2	times minimum bill,			5	per cent.	
" " "	3	"	"	"	10	"	"
" " "	4	"	"	"	15	"	"
" " "	5	"	"	"	20	"	"
" " "	6	"	"	"	25	"	"
" " "	8	"	"	"	30	"	"
" " "	10	"	"	"	35	"	"

"The minimum charge in the above case is based on 60 cents per lamp for the first five lamps of 16-cp or equivalent, and on 30 cents per lamp for each additional lamp of 16-cp or equivalent."

Of course, this method is not as popular with short-hour consumers as the plan of charging a fixed rate per unit, regardless of consumption; but the plan is, without question, more equitable and just to all concerned. All pay the increased expenses they cause, and in this way the long-hour consumers are not made to pay for the losses otherwise caused by the short-hour consumers. It is also possible to make concessions without encountering the dangers to be met with in discounting all bills of a certain amount or over, as where all bills of, say, $10 per month, or over, are discounted, a consumer having 100 lights and a bill of only $10 per month will get a discount, whereas he should have created a bill of from $20 to $30 per month, before he had reimbused the company for expenses actually incurred in order to provide him with light subject to his voluntary use.

The introduction of the minimum charge has checked the rapid rank growth which was bearing little fruit for the stockholders, and has given in its place a healthy and satisfactory increase in the company's business. About one person in one hundred will refuse to use the light, because he objects to the minimum charges, *on principle*. He thinks he is being compelled to pay something for nothing. A just and reasonable man, however, will soon see the fallacy of that argument. None will connect unless they either expect to use in excess of the minimum charge, or consider the light has sufficient value to make it worth the amount of the charge. A net increase of about 2000 lights, a decrease, with the above lamps added, of about 200 lights in the maximum station load, and a very satisfactory increase in the gross and net revenues have been made since the adoption of the minimum charge.

Standard Rules for Electrical Construction and Operation.

The movement organized by the National Electric Light Association for the purpose of preparing a standard set of rules to met as fully as possible the conditions that now exist, and which at the same time will prove acceptable to the various interests affected by electrical construction work, has resulted in interesting a number of the more important national electrical bodies and industrial organizations to whom a proper solution of the difficult problem at issue appeals.

The list of the bodies which will thus co-operate, together with their delegates, is as follows:

National Electric Light Association, W. J. Hammer; American Institute of Electrical Engineers, Prof. F. B. Crocker; American Street Railway Association, John A. Seely; National Board of Fire Underwriters, William H. Merrill; Western Union Telegraph Company, A. S. Brown; Postal-Telegraph Company, Francis W. Jones; American Institute of Architects, Alfred Stone; National Association of Fire Engineers, Capt. William Brophy; American Bell Telephone Company, C. J. H. Woodbury; General Electric Company, Lieut. S. Dana Greene; Westinghouse Electric & Manufacturing Company, Charles F. Scott.

The delegates of the various associations above named will meet in joint conference on March 18, but such delegates will not commit the bodies they represent to any definite action at the meeting. It is proposed that the various rules which have been promulgated by the several interests, electrical and insurance, shall be taken up for consideration and thoroughly discussed from the standpoint of the interests represented at that meeting, with a view to forming a new code comprising the best that is in the various sets of rules now in vogue, and new matter considered advisable; that the delegates should take part in the discussion and vote upon the various matters which would come up bearing upon the importance and value of the rules submitted, and after a code has been prepared which has met with approval of the various delegates attending the meeting, that such code be submitted by the various delegates to the bodies which

they represent with the attention that they shall ultimately, if it is deemed advisable by the various national organizations, be approved by them. It is not the intention that the questions taken up in the discussion shall commit the various organizations to any definite decision in this matter at this meeting or thereafter, if they should deem it inadvisable to co-operate.

Mr. W. J. Hammer calls attention to the unsatisfactory condition of things which exists to-day, and enumerates the following code of rules: That issued by the National Electric Light Association, which is largely the basis of all the rules used in the United States; the code adopted by the National Board of Fire Underwriters; the rules issued by the various illuminating companies; the rules of the Manufacturers' Mutual, of the New England and similar associations; the rules now about to be issued by the Fire Department of the City of New York, and similar organizations in other cities, the independent sets of rules prepared by consulting engineers, insurance experts, etc., which are more or less in vogue in the United States. He believes that the existence of these various rules, all of greater or less intrinsic value and importance, leads to much confusion, misunderstanding, expense, litigation, and frequently to the interpretation and enforcement of the various rules largely in accordance with the personal views of the local inspectors. By securing the adoption, promulgation and enforcement of one single standard which will meet with the approval of the various electrical, insurance and allied interests, and which rules shall be the result of the joint action of these various interests and not be fathered, by any particular association, electrical, insurance or otherwise, Mr. Hammer believes we shall arrive at a condition of things which has been hoped for and worked for for many years past. He therefore considers that as the preliminaries for the proposed joint meeting have been so successfully inaugurated, it is the duty of not only the various organizations which are co-operating at this joint meeting, but of electrical and insurance men and those connected with allied interests, to lend every assistance and encouragement in their power to secure the aimed-at and much-to-be desired result of the adoption of a single National Code of Rules.

Mr. Hammer, on behalf of the preliminary committee of the N. E. L. A., who are arranging the details of the meeting which is to be held in March (and probably on the 19th as well), extends an invitation to any one to send, either to his address, 1303 Havemeyer Building, New York, or to Mr. George F. Porter, secretary of the National Electric Light Association, 136 Liberty Street, New York, any criticism or suggestion upon any of the rules now in vogue, or matter which might be included in the proposed new code.

The American Society of Mechanical Engineers has extended the courtesy of the use of its headquarters at 12 West Thirty-first Street for the holding of the proposed joint meeting, on March 18 and 19, 1896.

The Geometrical Form of Transformer Plates.

BY LEWIS T. ROBINSON.

In the issue of THE ELECTRICAL WORLD of Jan. 11, an article under the above title arrives at some conclusions which seem decidedly wrong.

It is true that a transformer punching to give the least iron loss, with a given weight of material used, would have a shape giving the shortest magnetic circuit, together with a section throughout which would allow the magnetic flux a path of uniform section.

It does not, however, follow that the extra iron in the cores shown will augument the iron losses in the same. We can simply say that this extra material, while it decreases the iron loss somewhat, could have been more advantagously applied. That is, the increase in weight would not be attended by a decreased loss in the proper relation.

The calculations seem to be based on a constant loss per pound in the four shapes cited, no allowance being made for the decreased loss per unit volume in the overlapping and the thickened sections.

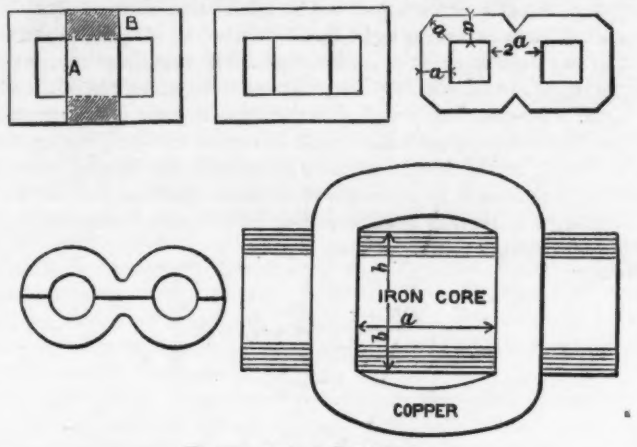
As the flux per unit section in the thickened parts of these plates would be smaller, and as the core losses decrease much faster than the flux density, the loss in the core as a whole would be reduced, although the loss per unit weight of core would not be at the smallest attainable figure.

In other words, taking Figs. 1, 2 and 3 and constructing them to enclose copper of the same shape in each case, the loss in Fig. 1 would be the least and in Fig. 3 the greatest, but Fig. 3 could be made better than Fig. 1 by increasing the section of it by the amount possible to bring its right up to that of Fig. 1.

Fig. 4 is of course an ideal type, but the same reasoning can be applied to it. If the two circular holes were punched in a rectangle of such a size as to just be covered by the greatest length and breadth of Fig. 4, the losses in the core would become reduced, but not in the most economical manner.

Considering merely the sum of Fig. 4, it is all right, but the copper would be hard to form in circular section.

Fig. 1 requires a copper coil of rectangular section and opening with sides two to one to include the same area of iron containable within a coil of square opening, using butt points. That is, a core



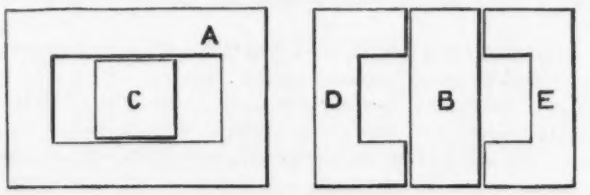
TRANSFORMER STAMPINGS.

of the same number of plates of form No. 1 must, to convey the same flux, be twice the length necessary, as the plates are separated by the thickness of one punching placed between each to make the joint. This point would probably be more to the discredit of Fig. 1 than the faulty distribution of iron.

Unless it is to give room for clamping bolts, etc., is there any use in employing complicated dies to make almost worthless scrap where the iron if allowed to remain in the plates, would slightly reduce the core losses although the distribution of the iron would not be theoretically perfect?

In a letter to the London *Electrical Review*, Mr. Ernest Scott also criticises the article of Mr. Adams, whom he declares to have fallen into the common error of supposing that the Mordey transformer core is built up as it is described in text-books.

The idea of punching a piece out of a rectangular sheet and then laying it across to form the centre piece, "thus avoiding waste of material and securing a good magnetic circuit with *ample ventilation*," as the text-books have it, is, says Mr. Scott, only half the story. The Brush Company soon found that in order to save copper



BRUSH TRANSFORMER STAMPINGS.

they must fill up the spaces between the stampings so as to make a solid core. There are five stampings for every two layers—*A* and *B* being cut out of one rectangular sheet, and *C*, *D* and *E* out of another. As the spaces between the plates were only .014 inch across, there was very little extra ventilation.

A Pacific Cable.

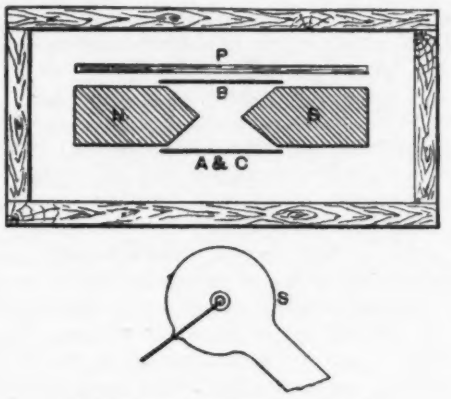
At a hearing last week before the Senate Committee on Foreign Relations, Mr. James H. Scrymser appeared to urge the interests of his company, which proposes to lay a Pacific cable. A bonus of $160,000 a year for a period of twenty years is asked from the government, and in return the company will bind itself to forever transmit all government messages free of cost. The rate proposed for private Japanese messages is $1.25 a word, and for Hawaiian messages 35 cents per word, the press rates to be one fourth of these. Mr. Scrymser stated that the only obstacle to the early and successful establishment of his cable is the so-called exclusive grant of the Hawaiian government to Col. Spaulding, which, he says, is in the interests of an English cable company.

On the Present Hypotheses Concerning the Nature of Röntgen's Rays.*

BY DR. OLIVER LODGE, F.R.S.

When I wrote the article last week (THE ELECTRICAL WORLD, Feb. 22), I was still uncertain whether Röntgen rays might not experience a trace of deflection in a strong magnetic field ; and this, notwithstanding the assertion of the discoverer that he had found no deflection. No details of the experiment had been given, and although it might seem safe to trust the bare assertion of so known an experimenter as Prof. Röntgen, yet, on account of the portentious gravity of the issue, I felt bound to satisfy myself by a direct confirmatory experiment. If only there were a magnetic deflection of the rays, the very simplest of all possible hypotheses would be confirmed—the hypothesis, viz., of a kind of sound-pulse conveyed by electrified particles, streaming on the whole in one direction, with interchanges of energy, passing on the motion in a Grotthüs-chain kind of fashion, but passing it on by simple material impact; a kind of electrolytic radiation, as I then expressed it. The details of this hypothesis were given by Prof. Fitzgerald in the columns of the *Electrician*, Vol. XXXII., p. 573, and Vol. XXXIII., p. 151.

My first experiment on magnetic deflection, the shadowgraph of a magnet with a background of wire gauze, only showed that if there were any shift by reason of passage of rays between the poles it was very small; but I have now definitely to assert that a further experiment has been made which effectually removes the idea of deflectibility from my mind, and confirms the statement of Prof. Röntgen.



MAGNETIC DEFLECTION TEST.

A strong though small electromagnet, with concentrated field, had a photograph of its pole-pieces taken, with a couple of wires, *A* and *C*, stretched across them on the further side from the plate—nearer the source—and a third wire *B* also stretched across them, but on the side close to the plate *S* is the source of radiation, *P* a sensitive plate, and *N*, *S* magnet poles. The sides of the wooden box are about one quarter inch thick. The wires *A* and *C* are one above the other, about half an inch apart, so that the shadow of *B* lies between them. These three wires left shadows on the plate, of which *B* was sharp and definite, while *A* and *C* were blurred.

A couple of radiographs were taken by Mr. Robinson, one with the magnet on, and one with the magnet reversed. On subsequently superposing the two plates, with the sharp shadows of *B* coincident, the very slightest displacement of shadows *A* and *C* could have been observed, although those shadows were not sharp. But there was absolutely no perceptible displacement, the fit was perfect. Consequently the hypothesis of a stream of electrified particles is definitely disproved; as no doubt had already been effectively done in reality by Prof. Röntgen himself.

But it must be noted that the hypothesis of a simple molecular stream—not an electrified one—remains a possibility. The only question is whether such an unelectrified bombardment would be able to produce the observed effects. In so far as it could effect photographic plates one would suppose it must be by means of phosphorescence, but it is doubtful whether it would even have the power of exciting phosphorescence.

It must be remembered that Dr. Lenard found among his rays two classes as regards deflectibility—some much deflected, others less deflected—and it must be clearly understood that his deflections were observed, not in the originating vacuum tube, where the fact of deflection is a commonplace, but outside, after the rays had been as it were "filtered" through an aluminum window. He did not, indeed, observe the deflection in air of ordinary density, it was in moderately rarefied air that he observed it, but he showed that the variation of air density did not affect the amount but only the clearness of the minimum magnetic deflection. The circumstance that affected the *amount* of the deflection was a variation in the contents of the originating or high-vacuum tube.

The hypothesis, therefore, that naturally suggests itself is that the highly-charged particles flying from the cathode deliver up the greater part of their charges when they reach the aluminum window, and that the outside particles which take up the running are less charged, some of them perhaps not charged at all. These last would not be so likely to excite phosphorescence, hence Lenard would not perceive them; he would only observe those that had managed to retain or acquire a modicum of charge, and these would be deflected.

The question has still to be asked, therefore, whether the rays discovered by Prof. Röntgen, which are not at all deflected, are those which possess no trace of charge.

Besides, it must be remembered that the absence of deflection has only been proved in ordinary air, while the presence of magnetic deflection has only been proved in somewhat rarefied air; the investigation into this matter is not finished until a further experiment is done, viz., to verify the non-deflectibility of the Röntgen rays even in a fairly good vacuum.

So much for what remains of the almost defunct radiant-matter hypothesis (defunct only, be it understood, for the particular kind of rays studied by Prof. Röntgen; and not really defunct for them, but in a state of suspended animation. The hypothesis of a bombardment of uncharged particles I have by no means yet abandoned).

The alternative hypothesis, as generally conceived, is some form of waves. True, no absolute necessity has been yet made out for a periodic disturbance traveling at a finite speed; but the circumstance that fluorescent materials are excited, and chemical action precipitated, suggests a periodic motion not altogether out of time with the vibration-frequency of molecules.

Let us grant, then, that this circumstance renders it likely that the cause of the Röntgen effects is to be sought in some kind of wave-disturbance in the ether. The next question that arises is, Is it of the nature of ethereal *light* or of ethereal *sound?* Is it such transverse or electrical vibrations as are obedient to the equations of Maxwell, or is it a mode of longitudinal disturbance requiring some generalization or modification of those equations in order to express it?

On the principle that we are bound to apply the simplest hypothesis until it can be shown to be insufficient, it is necessary to consider how far the hypothesis of transverse or electrical vibrations can be made to serve. The chief difficulty here is the transparency of electrical *conductors*. To Maxwell's waves, *i. e.*, to *light* of every kind, they ought to be opaque. But already the translucency of gold leaf has been a slight known difficulty in the same direction, and it has been shown that by postulating interstices or lack of homogeneity, *i. e.*, a structure not infinitely fine-grained with respect to the size of light waves, the difficulty can be more or less satisfactorily overcome. Why not, then, assume that these new waves are much smaller than any hitherto known? Why not assume that they compare closely in size with the atoms themselves? Indeed, if they compare in frequency, they *must* compare also in size if they are transverse waves, for the only pace at which such waves can travel through the ether is accurately known. That there is plenty to be said for this hypothesis is obvious from the fact that it appears to commend itself both to Prof. Schuster and to Prof. Fitzgerald. Among other things that can be said in favor of it are the following: Electrical oscillations in conductors are known to have the power of exciting light-waves, hence light-waves may be expected from electric oscillations or surgings in atoms; but visible waves are not so excited. Visible light appears to be due to something more like the sound-vibration of atoms, as if they were bells or plates struck and made to vibrate. Bells and plates of atomic size would vibrate at about the required pace, viz., 400 to 800 million million vibrations per second.

But electrical or Hertz-like oscillations of a charge on conductors of atomic size would vibrate immensely faster, being controlled not by the rate at which *sound* travels across an atom, but by the rate at which *light* travels, and this is about 100,000 times as quick. Hence, as has often been pointed out, electrical oscillations in atoms are too quick for light; but yet they must occur, one would think, when atoms are being violently disturbed and charged and dis-

* From the London *Electrician*, Feb. 7, 1896.

charged; and if ever such oscillations occur, tranverse waves must be emitted. Why should not these constitute the Röntgen rays?

This matter of the extra-rapid ultra-ultra-violet light may be safe if left in the hands of its supporters. Its great advantage is that it utilizes no new or unknown property of the ether—nay, more, it utilizes a disturbance which, although not yet otherwise discovered, must naturally be assumed to exist, unless definite reason is shown against it. It is needless to emphasize further the high probabilities in favor of this hypothesis. Such statements as there are against it will follow incidentally.

Now we come to the last hypothesis, the one suggested by Prof. Röntgen—the one which, judging from page 447 of your last issue, commands the high support of Prof. Boltzmann—the one which it is not to rash to assume is regarded not unfavorably by Lord Kelvin* —viz., the hypothesis of ethereal sound or longitudinal waves in the ether. The only facts hitherto assumed to utilize longitudinal or pull-and-push properties in the ether are the facts of gravitation and of cohesion. Newton himself showed that an ethereal tension or pressure would account for gravitation. Nothing is known about these properties, and there are difficulties in supposing that the ultimate space-filling medium can be really compressible. It is not, indeed, necessarily compressible to account for cohesion and gravitation, but it must either be compressible, or else simulate the effects of compressibility, if it is to transmit a periodic or atom-shaking disturbance at any finite pace.

Assume for the moment a slight compressibility of some sort, and consider what occurrences there are in a well-exhausted vacuum tube which could start longitudinal waves in such a medium. We have in the vacuum tube a violent torrent of atoms striking on the glass. Suppose that the vacuum is about 10^{-6} of an atmosphere—which appears to be something like that needed to give good effects —then the distance apart of the residual atoms in the exhausted space is a hundred times as great as in ordinary air, and a thousand times as great as in liquids; hence the distance will be about 10^{-5} cm; or each spot of glass will receive a hundred thousand blows from every centimetre length of the stream to which it is subjected. But the speed of the cathode rays has been directly measured by J. J. Thomson as something comparable to 10^{7} cm per second. Hence the glass will be struck on the average, at every point, 10^{12} or a billion times a second, by the mere procession of negatively-charged atoms. It is easy for this estimate to err by a factor 10, and it is also easy for places to be sometimes struck 10 times more frequently, by reason of the above estimate being only an average. Hence it may be surmised that the frequency of luminous vibrations are occasionally reached, and the glass not only grows hot but also shines.

It is probably quite unnecessary to appeal to this rapidity of bombardment in order to account for visible fluorescence, but the rapidity of bombardment is of interest because in any compressible medium such rudely periodic disturbances could hardly help starting some kind of sound waves.

But, besides that, the atoms themselves are known to be elastic, and to have definite periods of vibration like plates or bells, as evidenced by their spectroscopic lines; hence the blows to which they are subjected must be thought of as likely to excite vibrations or crispations in them. The frequency of these are such as to emit luminous waves in an ether possessing electromagnetic properties, the atoms being charged; but if they occur in an ether which is anything like a compressible fluid, how can they avoid exciting mechanical or sound waves, too?

Nothing can be known for certain about the wave-length or velocity of such waves in ether until an interference or diffraction experiment has been performed, but the order of magnitude of the frequency can be taken as that of light, say 10^{15} per second, or quicker. The only way at present to gather some idea of the wave-length is to attend (*a*) to the sharpness of the shadows, (*b*) to the thickness of medium which is effectively opaque.

The longer the wave the more transparent are things likely to be because waves are always damped out logarithmically, and this needs a certain number of swings, or at least a certain fraction of a swing, for notable damping to occur. A wave a yard long is not likely to be effectively stopped by an obstacle an inch thick. Without a knowledge of the damping-ratio, however, no numerical estimate can so be made, but a better estimate can be got from the sharpness of shadows. Take a point source, and investigate the outline of the shadow of an object held at a moderate distance from the screen or sensitive plate. No clear shadow will be thrown when the size of the obstacle is comparable to a wave-length, if its size is small, or when it is removed several wave-lengths from the plate, if the size of the obstacle is large. For, in wave theory, shadows are thrown by interference; and diffraction effects become prominent even when a want of precision about the source hinders the recognition of any clear diffraction pattern. The latter would not only indicate the wave-length, but measure. Short of that an estimate can be hoped for. Mr. A. W. Porter, in Prof. Carey Foster's laboratory, has obtained the sharpest radiographs I have yet seen, and he has the best chance of getting the data for an estimate. Suppose for the moment we guess that a wave-length of about 1 cm is not unlikely, then the speed of the hypothetical longitudinal waves would be of the order 10^{15} cm per second, or more, *i. e.*, about as much quicker than light, as light is quicker than sound.

Such waves if they existed might be reasonably styled gravitation waves; for, although gravitation does not need any wave propagation, only a state of statical stress or tension, yet it would be the rate at which the tension traveled outward if a fresh piece of matter started existence, or probably if an old piece of matter moved about with sufficient rapidity. Such motion would appear likely to entail aberrational effects, but aberrational questions are notoriously difficult, and the subject is only here mentioned because it is doubtful whether the Laplacian difficulty would be felt in astronomy if gravitation traveled a million times as quick as light. The pull of the sun would be felt in the time that light needs to travel 92 miles, and this is nearly instantaneous; or, otherwise, the terrestrial aberration-angle for gravity would be only the hundred-thousandth part of a second of arc.

But what about the Cavendish-Faraday-Maxwell experiment? that experiment which is held to establish the incompressibility of the ether, or the electrostatic law of inverse square, or the impossibility of a free or isolated electric charge (*see* "Modern Views of Electricity," Second Edition, pp. 9, 11, 29, 31-34, 257). We cannot tell what the volume-elasticity of the ether has to be, in order to transmit condensational waves of the above speed, unless we know its density. Dr. Larmor has shown some reason for supposing that ether may be as dense as platinum. If it be anything like that, and if the longitudinal wave velocity is 10^{15}, then the incompressibility is more than 10^{35} G. G. S. units; too great for any such experiment to show.

The object of mentioning these matters here is to help to realize that there is nothing in present knowledge obviously fatal to the idea of longitudinal waves in the ether; but the arguments in their favor, in connection with Röntgen rays, remain to be given. Assuming wave propagation of some kind, every argument against transverse is in favor of longitudinal, and *vice versa*.

Now the thing that suggested longitudinal waves to Röntgen was the fact that crystalline properties were of no importance: *e. g.*, that Iceland spar and quartz were equally transparent or opaque whichever way you turn them. But it must be admitted that such a test as that is next door to none. If *tourmaline* is transparent to Röntgen rays going along its axis it would be a much better test; and this I have myself ascertained to be the fact. J. J. Thomson also has found that a pair of ordinary cut tourmalines are equally transparent whether their axes are "crossed" or parallel; which is an excellent test. Nothing suggestive of polarization in any form has yet been observed; a fact which tends against transverse and in favor of longitudinal waves. But the strongest argument in favor of longitudinal waves is derivable from the fact that the rays discharge electrified bodies. Lenard found this, and J. J. Thomson and I have both obtained it easily under Röntgen-like conditions; but their peculiarity is that (unlike light) they discharge positive and negative about equally.

Now, Elster and Geitel showed that when polarized light discharges a really smooth surface it is most effective when the electric oscillation is partly normal, not tangential, to the surface; in other words, that it is what may be called the longitudinal or end-on component of ordinary light that is by far the most effective in discharging electricity.

Mr. Robinson thinks he has observed that the same thing is true

*In this connection it is interesting to refer to Lord Kelvin's Presidential Address to the Royal Society, Nov. 30, 1893 (Harrison & Son, London), on the subjects of Hertz-waves and Radiant Matter, in which he confidently anticipates further progress and gives an interesting *resumé* of the history of highly exhausted vacuum-tube effects in connection with that subject. He emphasizes the important part played by Cromwell Varley in 1871, before either Hittorf or Crookes, in the discovery of cathode rays, and strongly supports the material view, in opposition to many Continental workers.

as regards the power of exciting fluorescence: an important observation if true, but the examination is not complete yet. If it turns out so, then the two things that Röntgen rays are known to do are characteristic of end-on or normal vibrations.

As to the photographic or *radiographic* action, it is so slow and inadequate at present that it hardly looks like a direct primary effect, but even there it seems as if thick films did better than thin.

Another fact that gives a gravitational look to Röntgen's rays is the fact that they appear to pay more attention to specific gravity or ordinary density than to any other property of matter. This can be said without stating that opacity and density are strictly proportional. Anyway, electrical properties of matter seem to be quite unimportant; polish or roughness, a coherent block or a powdered mass, are all the same to these waves, as they are to gravity.

Direction of crystallization matters nothing, nor does shape; an aluminum prism cannot bend them; they cannot be bent or even reflected to any considerable extent. If it be found that physical state is also unimportant, so that the same molecules obstruct equally, however they be aggregated, whether into solid, liquid or gas, that will be a further contribution to the evidence in the same direction.

Thus there is plenty of scope for experiment. A few weeks may be sufficient to intensify our conviction in one or other of the already-mentioned directions, or we may find ourselves urged by new facts in some other direction not yet thought of.

In conclusion, let it be remembered that Lenard, Hertz, Goldstein and the Germans generally (except Helmholtz—a notable exception!) have consistently urged that cathode rays were something more than a stream of particles; in case it should so turn out, Lenard urged this for his rays outside, in air, Hertz, I believe, urged it for the rays inside the vacuum. It may be that the streaming particles are there, but an ethereal process may be also there. Outside in the Lenard rays both processes possibly coexist, one deflectible by a magnet, the other not. That both processes exist also inside the vacuum is not likely. J. J. Thomson has exposed a protected plate in the very rays themselves inside the vacuum and got no result. It looks as if the streaming particles alone could not achieve it.

If the sun emits any rays that can reach photographic plates through boxes or hand bags, even through black paper, every touring photographer should know; but if cathode rays alone have no direct action, without the intervention of a phosphorescent substance, then even the absence of direct solar action would constitute no valid and conclusive proof that the coronal rays are not electrical, though it would very much militate against a method of easily obtaining a photographic record of the corona which has been suggested.

Tests of Fuse Wire.

To the Editor of The Electrical World:

SIR:—In your issue of Feb. 15 I noticed an article on "Tests for Fuse Wire," which was read with great interest, as the results are very similar to those which we obtained from a series of tests made on Jan. 8, 1896. The fuses tested were of the ordinary commercial variety, and were marked, warranted and tested for their carrying capacity. The connections were made across the lines of a 102-volt Westinghouse alternating circuit and an ordinary 20-ampere main line fuse block was used. The fuse tested was in each case placed in the block in a vertical position, uncovered, and with a distance of 1¼ inches between terminals, in order to correspond as nearly as possible to the conditions which occur in practice. In the first test with a three-ampere fuse six amperes were carried for two minutes with no discoloration of the fuse. When the current was increased to seven and one half amperes the fuse blew in four seconds. Replacing the fuse and repeating the test, a current of seven and one half amperes was carried for 11 seconds, when the fuse blew.

The next fuse tested was rated at five amperes. A current of nine amperes was carried for three minutes with no appreciable results. The current was then increased to 10½ amperes. After 30 seconds one of the 10-ampere fuses on the main circuit blew. This fuse was replaced and the current again thrown on. After 40 seconds more the other 10-ampere fuse on the main line blew. This was replaced and the experiment tried again. After carrying a current of 10½ amperes for three minutes the fuse wire was perceptibly hot, but still intact. The current was increased to 12 amperes and was carried for three minutes, with a dull reddening of the fuse, but no explosion.

In the next test a No. 30 B. & S. gauge copper wire was tried, and carried currents of four and one half, six and seven and one half amperes for three minutes respectively with no perceptible results, except a slight rise of temperature in the latter case. At a current of nine amperes it blew in four seconds. A 24-inch piece blew in 11 seconds at seven and one half amperes, while an 18-inch length carried six amperes for one minute, although its temperature was considerably raised and it blew in two seconds when the current was increased to seven and one half amperes. A piece of No. 86 B. & S. gauge copper wire one and one quarter inches in length blew in two seconds at four and one half amperes, although it carried three amperes for three minutes.

JULIAN DU BOIS.

ALBANY, N. Y.

Does It Pay to Use Cheap Oil?

To the Editor of The Electrical World:

SIR:—The oil question is one of great importance to the superintendents or chief engineers of the many railway power stations and electric light plants now so thickly scattered over the country and still increasing in number, though not so recognized by all of those interested.

A diversity of opinion seems to exist among many superintendents and engineers on this subject. One man will maintain that he can use a cheap grade of oil and experience no trouble; when asked about repairs, he will perhaps answer, "Yes; we have plenty, but we would have them anyway," so that settles the matter with him. Another wants the best oil and gets it, and as a rule you will see in his station everything in keeping; he has little trouble on account of repair bills, while everything seems to be running smoothly.

The tendency is toward direct-connected generators in railway power plants, with armatures of many tons weight, and fly-wheels still heavier, oftentimes amounting in all to 40 or 50 tons weight distributed between two bearings.

Think for a moment, and make a few calculations on the basis of a weight of 50 tons at a speed of 85 or 100 revolutions per minute; think how much frictional work is expended on such a bearing; compare it with those of engines of some years ago, with their 15-ton fly-wheels and speed of 50 or 60 revolutions per minute. Consider some of the latest plants, with three or four large cups, one used on each bearing, and an oiler kept busy constantly chasing around with a large oil can filling up; or you may see an elevated tank pouring on a stream of oil, which by means of a pump is returned to be used over and over again—a substitute for the "oiler" and a good one, too. Then for a moment refresh your memory concerning the "days gone by" when engines were jogging along at 50 or 60 revolutions and oil cups were filled every two or three hours. But I hear some one say, "Things have changed." Just so. Competition has stepped in, the sizes of bearings have been cut down by the makers to the lowest possible limit; the oil merchant has cut down his price to the requirement of some railway managers (also the quality), for it should not be forgotten that he is in the business for money and not for charity.

The writer has had experience with all kinds of machines over a period of 27 years, and the knowledge derived during that time has taught that the best oil is none too good. With good oil machinery will last longer, repairs will be less, the satisfaction of all interested will be general, and at the year's end, more money will be in pocket.

CHESTER, PA. RAILWAY ENGINEER.

Telephones for the Erie Canal.

A bill has been introduced in the New York State Legislature appropriating $500,000 for the purpose of constructing a telephone line along the Erie Canal to connect the divisions and main office at Albany as well as the locks and division superintendent's office.

The Drawbaugh Telephone.

Daniel Drawbaugh and his representatives were before the Senate Committe on Patents on Feb. 15, advocating the passage of a bill that will enable him to go before the Patent Office and prosecute his claim for a telephone patent, from which he has been debarred by reason of the finding of the Patent Office that his invention was in use for more than two years before his application was filed. Drawbaugh contends that it was only in use as an experimental affair, and not commercially, as required by the law. His alleged invention is similar to those upon which the Berliner patents, now in the Supreme Court, are based.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

DYNAMOS, MOTORS AND TRANSFORMERS.

Alternating-Current Transformer. FLEMING.—The third lecture of Dr. FLEMING is briefly abstracted in the London journals Feb. 7; among other things he gives the following rules: From the deflection in a ballastic galvanometer of known resistance, when the number of windings of the coil of the transformer is known, the whole induction through this coil, on the sudden withdrawal of the induction from the coil, can be determined as follows: Webers × linkages = coulombs × ohms; or microwebers × linkages = microcoulombs × ohms; one weber being equal to 10^8 C. G. S. lines. He discussed the various methods of testing transformers, and expressed his astonishment that so few central-station engineers have taken the trouble to test the transformers which they purchased. The lecture is concluded with an experiment showing how a bad magnetic leakage in a transformer could be detected by the rotation of a pivoted iron disc held in the region of the stray field.

Armature Windings. ARNOLD. *Elek. Zeit.*, Feb. 6.—A continuation of his article (see *Digest* last week); it contains a number of clear diagrams illustrating different forms of windings for multipolar machines with two or more brushes; the description does not admit of being abstracted.

Formulas for Calculating Three-Phase Motors. BEHN-ESCHENBURG. *Elek. Zeit.*, Feb. 6.—The conclusion of his long article; (see *Digest*, Feb. 1.)

Multipolar Armature Windings. MUSCHENHEIM. *Elec. Jour.*, Feb. 1.—A reprint abstract of a paper read before the Chicago Electric Association, giving diagrammatic illustrations of a number of different windings.

LIGHTS AND LIGHTING.

Dispersion of Light from Diffusing Surfaces. Zeit. f. Beleucht., Jan. 30.—The beginning of an article giving a general summary of the most important results of experiments made up to the present time.

Electroliers and Fittings. Lond. *Elec. Eng.*, Feb. 7.—Illustrations of a number of designs.

POWER AND HEAT.

Electric Welding. Lond. *Elec. Rev.*, Feb. 7.—An illustrated description of the apparatus and products in a factory in England in which the Thomson system is used. Among other things it is stated that not one out of 500 welds turns out to be a failure, or even defective; regarding the question of cost, it was found that on straight-forward welds the total cost is between 10 and 15 per cent. more than that of ordinary smiths' work, whereas, for the delicate and difficult work, the cost is probably one third of that of the smiths' work; it is thought that it is not so much the economy as the method of securing absolutely reliable results, which is the important feature, as also occasionally the saving of considerable expenditure by its special adaptability.

Zerener's Welding Method. Lond. *Elec. Eng.*, Feb. 7.—A translation in abstract, together with two of the illustrations, of the article abstracted in the *Digest*, Feb. 15.

Use of Low-Grade Fuel. Cassier's Mag., February.—A note calling attention to a plant near Bitterfeld, Germany, where there are large deposits of bituminous coal of such a low heating value that the cost of transportation would prohibit its use at any distant place; a large electro-chemical establishment was therefore erected a year ago, it being the largest in Europe, having a capacity of 2000 hp; it produces chiefly chlorine and caustic potash by the Rathenau process with such good results that an increase to 300 hp is under way; calcium carbide, sodium and refractory metals are also produced on a large scale.

Steam Plant for a Small Station. CARPENTER. *Cassier's Mag.*, February.—An article of some length discussing steam plants for small light and power stations.

Long-Distance Transmission in the United States. MCGHIE. *Cassier's Mag.*, February.—An illustrated description of a number of plants.

Water-Power. WEBBER. *Cassier's Mag.*, February.—A short discussion of the subject.

Electric Heating in Dental Practice. CUSTER. *Sc. Amer.*, Feb. 22.—A short article calling attention to the various uses of electric heat in dental practice.

TRACTION.

Coal Consumption on French Railways. CADIAT. Lond. *Elec.*, Feb. 7; a brief note from a French journal.—On the storage battery line to St. Denis and Neuilly the car mileage in 1893 averaged 1376 per day, requiring steam engine power at the rate of 4.72 hp-hours per car mile, at 2.75 pounds of coal per hp hour, or 12.98 per car mile. On the trolley line at Marseilles an average of 7.7 pounds of coal per car mile was used, but this includes lighting the cars and the power station.

The Coming Locomotive. WEBB. Lond. *Elec. Eng.*, Feb. 7.—He is quoted as saying that he was prepared to run electric railways (referring to the substitution of electric for steam power on steam railways), and predicted that a few years hence electric trains would be run to all the great centres at a speed which could now hardly be realized. (He is chief locomotive engineer of the London & Northwestern Railway Company, one of the large railway companies in England.)

Electric Traction. DAWSON. Lond. *Elec. Rev.*, Feb. 7.—An article on electric traction in the light of recent developments, including brief descriptions of some European plants and some matter from American papers.

Electric Traction on Railways. BAXTER. *Elec, Eng.*, Feb. 19.—The first part of an article on the question of whether electricity can supplant the steam locomotive on trunk railways. He calls attention to the fact that the cost of the fuel is but a small percentage of the cost of operating a railway system, and that any saving of the fuel is therefore not of very great importance; he intends to show how electricity can base a claim of superiority; he claims that there is no such difference in coal consumption between the best type of triple expansion stationary engines and the best locomotives, in favor of the former, as is claimed by some authorities; an efficiency of two pounds of cheap coal per hp-hour is as much as any conservative engineer would claim for a stationary engine while the locomotive he claims is one of the most economical of non-condensing engines when run at a high speed.

The same journal reprints an abstract of a paper from the German by LEISSNER, read before a society of railway engineers. He claims that the results for the past two years with electric traction on trunk lines are negative; the hopes of attaining unusually high speeds are shattered; "our generation will not see such schemes revived;" a single car service is impracticable on lines of dense traffic and it would reduce their efficiency, nor is it compatible with safety, the only thing left therefore is to replace the steam locomotive with an electric locomotive leaving everything else as it is; he condemns the independent electric locomotives; the results with dependent ones at Baltimore, Nantasket and Mt. Holly are encouraging, but far from satisfactory; only a small fraction of the power is realized as draw-bar pull. Some estimates of the efficiencies under different circumstances are given and from this he concludes that there is no advantage to be gained by a change so far as coal consumption is concerned; the great first cost of the power stations will prevent a change at present; reserve requirements will be less with electric than with steam service; the cost of maintenance is also in favor of the former as are also reliability, regularity and safety of operation. There is a certain excursion traffic, which lasts a few days only and which offers no difficulty with steam locomotives; such a traffic is regularly recurring, but it would be unreasonable to adopt an electric installation to meet it. He believes the solution of the electric long-distance service problem "must be expected from the development of the alternating-current apparatus."

It is stated in the same journal that the Dedham branch of the N. Y., N. H. & H. R. R. will certainly be equipped with electricity during the Summer.

Recent Interurban Railways. St. Ry. Jour., February.—An illustrated description of some of the most recent lines.

Locomotive. Elec. Rev. and *Elec. Eng.*—A note on the first electric locomotive built by the Westinghouse and the Baldwin Companies conjointly. It is 30 feet long, is built entirely of steel and is mounted on eight wheels 42 inches in diameter; it will have 800 horse-power, and can exert double this for short intervals; at the former rate it will draw a loaded freight train at 40 miles an hour; it is operated by one man.

Substitution for the Trolley. West. Elec., Feb. 22.—The arrangement used in Europe, described in the *Digest*, Feb. 15, is illustrated and described; also a new device of the Siemens & Halske Co., of this country, which consists in a compromise in the form of the horizontal bar used in Europe with a trolley wheel in the middle, the upper edges of which are flush with the bar; on straight lines the trolley wire will run in the trolley, but on curves it will slide on the bar.

Power Distribution for Railways. BELL. *St. Ry. Jour.*, February.—The first part of an illustrated article on the arrangement of the wiring for the distribution of the power.

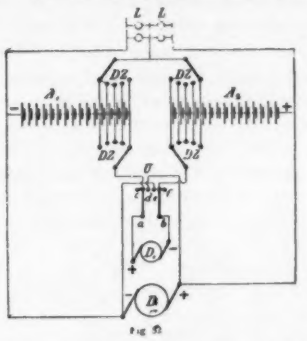
Conduit System. *Sc. Amer.*, Feb. 22.—A full-page illustration showing details of the system in New York, accompanied by a brief description.

Conduit Railway. CONNETT. *St. Ry. Jour.*, February.—Some notes on the operation of the line in Washington.

Motor Vehicle Contest. *Elec. Jour.*, Feb. 15.—A reprint of the report of the engineering committee.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

New Three-wire System. LIVSCHITZ. *Elek. Zeit.*, Feb. 6.—A brief, illustrated description of a new system which is in use in Russia. The central station contains dynamos of 250 volts, and a total of 1500 amperes; there are 136 accumulators with a maximum discharging current of 200 amperes; the problem was to devise a system which was as simple and as cheap as possible, and in which the charging current was independent of the current in the external circuit, at the same time permitting each half of the battery to be charged separately to restore the balance; no such system existed, and he therefore devised the present form, which is shown in the accompanying illustration. *D* represents the 250-



volt dynamos; D_1 is an auxiliary dynamo for charging, and has about 150 volts; *U* is a double pole switch; the rest of the diagram explains itself. If there is no charging, the small dynamo is at rest and its connection is broken, the accumulators and the large dynamo then act together or the former may act separately; during the charge of both batteries the small dynamo generates the necessary voltage, and the switch *U* is then in the position shown; if it is desired to charge one half of the battery separately to restore the balance the switch *U* is moved to the right or left, in which case the respective half will be charged separately by the small dynamo.

Rectifying Plant in Zurich. *Elek. Zeit.*, Feb. 6.—An illustrated description of a large plant in Zurich in which the alternating-current from a central-station is rectified for charging accumulators for a large amusement hall. The alternating central-station in that city was already fully loaded during the lighting hours, while the day load was quite small, and when this large amusement hall was to be connected it was decided to store the current for it during the daytime in accumulators, to be used in the evening for lighting; the consumption in this one building is equal to a load of 2000 lamps of 16-cp; the Pollak rectifier is used in its improved form, in which the loss in the transformation has been reduced to a few per cent.; the current is supplied through two transformers of 30-kw each, together with two auxiliary transformers of 15-kw each, which are connected in series with the others, giving 55 volts additional to the 105 delivered by the former; the auxiliary transformers are provided with 10 contacts with different parts of the coils, in order to provide for a regulation of the voltage; this method of rectifying is said to be extremely simple and the brushes on the rectifier need scarcely be moved; a complete diagram of connections of the whole system is given; the battery consists of two series of accumulators connected to a three-wire system; there are in all 113 Pollak cells of a capacity of 1528 ampere hours at a four hours' discharge at a maximum current of 472 amperes. In addition to the rectifier there seems to be a reserve transformer consisting of an alternating-current motor coupled to a direct-current dynamo.

WIRES, WIRING AND CONDUITS.

Electric Lighting Rules. Lond. *Elec.*, Feb. 7.—The publication in full of the new rules of the British Board of Trade in their final form.

ELECTRO-PHYSICS AND MAGNETISM.

Roentgen Rays. J. J. THOMSON. Lond. *Elec.*, Feb. 7.—He describes a method of testing their presence by a more delicate and expeditious method than the photographic plate and more easily adapted to quantitative measurements. When a large insulated metal plate is exposed to these rays it rapidly loses its charge; this test is so delicate that he has been able to detect the rays after passing through a one quarter inch zinc plate. Leakage caused by these rays differs from that due to violet light; the Roentgen rays discharges positive as well as negative electricity and the leakage goes on even if the plate is imbedded in paraffin or other insulating material which shows that "all substances through which the Roentgen rays are passing become for the time conductors of electric ity." He considers it suggestive both as to the nature of the rays and of the conduction through the insulator.

The London *Elec. Rev.*, Feb. 7, contains a good summary of what is known regarding these rays, including however, nothing new. It is believed that the difference between the Lenard and the Roentgen rays will turn out to be one of degree and not of kind. "Transverse vibrations of the ordinary light rays may after all be the transverse vibrations of the molecules of matter produced by the impact upon them of longitudinal ethereal waves;" the vortex atom can be readily imagined to have the property of transforming a longitudinal impact into a transverse vibration, and it is then no longer necessary to suppose that the ether is a quasi solid with transverse elasticity; all that is necessary then is to consider the ether as a gas like the air. Prof. Neusser, of Vienna, by means of Roentgen photographs, showed gall stones in the liver of a patient; it was quite opaque to the rays; malformations of the bones of the feet and pieces of glass and bullets in different parts of the body have been clearly shown in photographs taken by a number of different experimenters.

According to *La Nature*, Feb. 8, PULUJ's experiments have shown that diseased bone appears more porous on the photograph than healthy bone; a reproduction in that journal shows this slightly, but it does not appear to be a photographic reproduction of the original plate. He is at present experimenting with bullets in the body, one case being that of a young man who has a bullet in his head, but does not appear to be suffering from it; whether he has succeeded in the latter case is not stated.

An article in the *Zeit. f. Electrochem.*, Feb. 5, by Dr. NEUHAUSS, states that it often happens, when the voltage is too high, that sparks break through the Crookes tubes, thereby injuring them; experiments made at the Siemens & Halske laboratory have given surprisingly good results with an entirely new apparatus, which will soon be described; the only thing which he can say at present is that a relatively small spark coil giving a spark of 4 to 5 cm (1½ to 2 inches) is all that is necessary; the danger of sparking through them therefore no longer exists; the novelty consists in "the treatment of the primary current."

The *Zeit. f. Elek.*, Feb 1, states that Dr. Puluj found that the transparency of bones is not the same in all their parts, and it is therefore possible to obtain not a mere shadow picture, but shaded images; he also found that feathers were almost completely transparent, and that it was therefore possible to photograph the bony structure of a bird. In the same journal it is stated that Prof. Boltzmann obtained a photograph of a dead hand which not only showed the bones and a ring on the finger, but also the arteries and indication of the muscular structure.

In a note in the Lond. *Elec. Eng.*, Feb. 7, the word "electrosciography" is suggested for the process of taking the photographs.

In *L'Elec.*, Feb. 8, Mr. NODON reproduces a number of illustrations and discusses briefly the theories. Among other things he states that the objects to be photographed should be placed at least 6 or 8 centimetres (at least 2 to 3 inches) from the tube, for if too near the phenomena seems to be modified, the rays appearing to tend to encircle the opaque objects, and the Roentgen and cathode rays seem to be differentiated; he thinks there is no real difference between them; if a steel needle which has been magnetized is photographed the images of the two poles will be different, but in what way is not stated; experiments with living frogs showed that the intestinal organs came out clearly while the heart and lungs were invisible. He refers to some experiments made in Paris, in which it appears that these rays produced a rapid discharge of a gold leaf electroscope, after having passed through a number of substances such as aluminum, cardboard, wood, etc., while this discharge action is very slow and is reduced even to zero, by intercepting the rays with platinum, lead, zinc, etc.; the same method was tried for the voltaic arc, and it confirmed the negative results obtained with photographic plates, from which he concludes that the arc in the open air does not contain these rays.

Cathode Rays. JAUMANN. Lond. *Elec.*, Feb. 7; transulated from *Compes Rendus*, 122, No. 2. A reply to the note of Poincaré mentioned in the *Digest*, Feb. 22.—He concludes that he need not yet modify his hypothesis, but that it would not be difficult to do so in order to meet Poincaré's objection, which he considers interesting, as "it opens a discussion on the direction of the rays of the first order, a question which presents so many difficulties in the case of luminous rays of the second order."

Passage of Electricity Through Gases. LEHMANN. *Zeit. f. Electrochem.*, Feb. 5. An illustrated article of some length, giving a summary of a number of papers, chiefly from the *Weid. Ann.*—The view which is accepted most generally now is that the process of discharge is not like electrolytic conductivity, depending on the presence of ponderable atoms, but is a particular mode of motion of the ether filling the spaces between the atoms, which motion would take place much more freely and completely in pure ether free from atoms than in gases. He gives preference to the theory of Faraday, which assumes a breaking down of the molecules as a result of too high voltage. The disruptive discharge is characterized by the following properties: it takes place only when the difference of potential in the gases has reached a certain value, which he calls the discharge gradient; it is always confined to a sharply defined limit, which he calls the aureole; it is not a part of a closed conducting circuit, but

part of a so-called open circuit which is completed through a dielectric; the voltage between the electrodes is nearly independent of the current strength, and Ohm's law therefore does not apply; the heat of the current is not proportional to the square, but to the first power of the current, and therefore Joule's law does not apply. He discusses each of these in turn, with special reference to the question of whether the discharge is continuous or oscillating. Regarding the heat generated, he states that from the constancy of the voltage between the electrodes it follows that the heat of the discharge is not proportional to the second, but to the first power of the current, as has been proved; this fact is also a proof that the discharge is not continuous; he concludes that Faraday's hypothesis is until now the one which agrees most satisfactorily with observed phenomenon. Among the illustrations is a full-page plate with colored illustrations of the discharges, and the aureoles around them.

Effect of Temperature on the Resistance of Paraffin and Resin Oil. Gaze. Lond. *Elec.*, Feb. 7.—An article accompanied by a number of curves, giving the results of an extended series of experiments with these two materials at various temperatures within the ranges met with in commercial apparatus. The insulation was measured between two brass plates of equal area, one mm apart, placed in a bath of the material and surrounded by another bath of the same material, which latter was heated; a condenser was charged through the substance to be tested for 60 seconds and then discharged through a ballistic galvanometer; the E. M. F. was 110 to 120 volts; the paraffin was the ordinary white commercial wax. At normal temperature the specific resistance was not less than 10^{18} ohms; no appreciable change occurred up to 55° C., the temperature of solidification, but at this point it suddenly fell to 4×10^{13}; up to 120° the fall was steady, then a rise occurred with time, for about an hour, after which it was steady; on cooling, the values were all much higher and when cooled the resistance was too high for measurement; when the cycles were repeated on four successive days the values were lower for each successive series. When heated to 135° the insulation deteriorated steadily with time, but on cooling the material was found to be permanently damaged, the specific resistance being 6.5×10^{14} and the wax was slightly tinged with yellow. A six-hour test at 123°, which is the critical point, showed that the improvement is only temporary, lasting but an hour, after which the resistance falls; there was no distillation of impurities to explain the result; he explains the phenomena by suggesting that a molecular change takes place at 125° C., considerably increasing the resistance; this lasts about one hour and is accompanied by a slow decomposition which shows no signs of ceasing during six hours. He concludes that up to 100° C. there is no permanent injury, although the resistance is enormously diminished, but a long continued heating up to 130° or more, causes a permanent and marked deterioration, making it quite useless for resistance coils even though the change in color may be hardly perceptible. Similar tests were made with resin oil, the specific resistance of which at 18° C. was found to be 3.2×10^{14} ohms; as the temperature was raised the resistance fell, at first rapidly, then slowly, becoming constant after about 30 to 40 minutes, which time was less, the higher the temperature; at 25° the resistance was about ¼ and at 45, $\frac{1}{16}$; curves and a table of data are given; on cooling, the material was found to be uninjured and repeated heating had no effect on the resistance at normal temperatures, thus showing that resin oil was quite free from permanent deterioration at those temperatures, but the reduction of the resistance at no unusual temperatures is sufficiently great to be taken notice of in using it as an insulating material.

Phase Difference. Puluj. *Zeit. f. Elek.*, Feb. 1.—The conclusion of his article (*Digest*, Jan. 25).

Magnetic Influences of the Planets. Lond. *Elec.*, Feb. 7.—A brief reference to the meteorological records of the St. Petersburg Academy of Sciences, Vol. 17, in which there is a discussion of the magnetic observations and their bearing on the influences of the various planets, from which it appears that all the planets exercise a marked influence on the absolute value of the declination and on its diurnal variations; all the planets except Mercury increase these values when near the earth; the extreme values of the declination differ in the year by 0.85 minutes; taking this as unity, the amplitude of variation corresponding to an entire synodic revolution is as follows: Mercury, 0.58, Venus, 0.61, Mars, 0.59, Jupiter, 0.40, Saturn, 0.12, Uranus, 0.15, Neptune, 0.27. In the current number of *Nature* Prof. Schuster criticises these influences, and considers that this planetary effect may for the present be set aside.

Roentgen Rays. Case. *Elec, Eng.*, Feb. 19.—He concludes from experiments that sensitized plates can be acted upon in any place in which vacuum tubes will glow; also that a vacuum tube deflects the rays, causing an imperfect shadow, which he thinks may show that a vacuum is a path of less resistance.

Mr. Robertson in the same journal states that experiments which are now being conducted may show that magnetic lines of force alone, when properly directed, will produce all of the Roentgen ray effects. He believes that the arc light will produce all the effects, and describes an experiment in which impressions were produced on a photographic plate placed in a wooden box and exposed to arc light rays; a thin piece of iron and a piece of glass were used as objects and were found to act as with Roentgen rays. (There appears to be nothing that shows conclusively that it was not due to ordinary light which had filtered through; had both objects been opaque to light and one of them transparent to these rays the experiment would have been more conclusive.)

Dr. Morton in the same journal refers to his previous article (*Digest*, Feb. 15), in which he produced the effects with an influence machine, and states that the results have been amply confirmed, and that it is not so much a question of a brush discharge as it is a phenomenon, associated with the disruptive discharge. He describes what he calls a conclusive experiment, which he believes demonstrates the unquestioned fact that "cathodography on a large and intense scale can be pursued and accomplished simply by the aid of charging Leyden jars"; he believes the pictures produced by lightning discharges on the human body, of objects between it and the discharge, are probably due to the interception of these rays; his method consists "in utilizing a current discharge from static machines provided with Leyden jars, or even not so provided, which he describes in 1881, and again in an extended paper with many illustrations, in 1891; the essential feature is to introduce a spark gap, and use the high-frequency current between the external armatures of the Leyden jars, passing them through a vacuum bulb, from which Roentgen rays will then emanate; the vacuum bulb has only one terminal in the inside, the other being a disc on the outside; he states that the rays thus produced are of extraordinary power and intensity, the trouble which he experienced being in reducing the time of exposure and lengthening the distance, rather than the contrary.

Prof. Schuster's letter from *Nature*, Jan. 23, abstracted in The Electrical World last week, is reprinted in the *Elec. Eng.*, Feb. 19. He believes that the evidence offered by Roentgen indicating that the rays do not differ from light rays by the smallness of the wave-length, is not conclusive; there can be no doubt that they are not cathode rays; an absence of interference would not show that the radiation is not of the nature of ordinary light, but merely that the disturbance is not sufficiently homogeneous; that this is the case he thinks is not at all improbable as the radiation is produced by an impact which may at first be an impulsive motion outward, and after passing through the screen would only possess such regularity as is impressed on it by the absorption of the longer rays; the great argument against the supposition of short waves is the absence of refraction, but he does not consider this conclusive. There seems nothing impossible in the supposition that light rays smaller than those we know of may traverse solids with the same velocity as a vacuum; the whole question of refraction probably resolves itself into one of resonance effects and therefore the rate of propagation of very short waves does not seem to him to be prejudged by our present knowledge; if Roentgen rays contain very short waves the vibrations in the molecule would seem to be of a different order of magnitude from those so far known; we may have here the vibration of the electron within the molecule instead of the molecule carrying with it that of the electron. No one has given any good reason why an invisible light ray should be able to run around in a spiral while a visible ray goes straight.

The article by Mr. Bottomly abstracted in The Electrical World last week is also reprinted in full.

In the same journal Mr. d'Infreville describes his method of photographing and seeing in darkness, which has only an indirect bearing on the subject of Roentgen rays; it is the process which he referred to, but did not describe, in a former article. The process consists of two parts, the first is to cast on the object invisible ultra-violet rays; he believes that the Roentgen rays are "far up in the ultra-violet"; he produces these rays by decomposing light through a quartz prism, allowing only the ultra-violet ones to pass out; the second part consists of a process by which they may be photographed or seen; this seems to consist in simply photographing it in the usual way on plates sensitive to ultra-violet rays; to see the object he uses a telescope with quartz lenses focusing the image on a flourescent substance.

The same journal reproduces images of 30 different substances, as determined by Mr. Edison. It also states that he is experimenting with the effect of these rays on various germ cultures. It states that Prof. Salvioni uses a cylinder of cardboard coated inside with a fluorescent material and having a lens at one end; an object to be examined is placed between the source of the rays and the cylinder; on looking through the lens the outline of the shadow of the concealed object on the fluorescent interior is seen. E. P. Thompson suggests observing objects in motion by means of a tube having a fluorescent screen at one end, the eye being placed at the other. It is reported that Profs. McLellan and Wright have succeeded in reflecting and focusing the rays by means of a glass bell jar covering the vacuum tube and that instantaneous records can be taken by such focused rays. Park Benjamin calls attention to the "tithonic" rays described by Draper and noticed by him in 1841; they are a class of chemical rays analogous to the rays of dark heat; he found paper and quartz far more permeable than pure plate glass; a large number of bodies obstructed these rays. The Roentgen process has been tried at the Carnegie Steel Works for examining iron structures, but the results were not encouraging.

El'ty, Feb. 19.—Some experiments by Dr. Pupin with a large six-plate Holtz machine; most satisfactory results were obtained with electrodeless tubes and from a regular pear-shaped Crookes tube; the exposure for a hand for instance was only 14 minutes. He maintains that the time of exposure and not the possible existence of different kinds of Roentgen

rays, as implied by Lodge, some of which penetrate more easily than others, is the true cause of the difference of the photographs produced by Roentgen and those obtained by others; with a sufficient exposure the bones can be made to disappear and if they contained any metallic particles they would show in the record; over-exposure cannot be spoken of as it depends on the effect desired; his experiments support his theory regarding the exposure, and if the theory is correct it will be possible to locate bullets and like bodies in the interior of the bones (in that case, perhaps, also if they are in the interior of the skull). A fresh Crookes tube requires a relatively small voltage, but after a few hours' use the tension necessary for a discharge rises enormously and the Roentgen effect improves; he therefore considers that the vacuum continually improves with use.

The same journal contains a long communication from Dr. Morton claiming priority in the use of a bulb having an external electrode and connected in circuit between the outside coatings of two Leyden jars which are being charged and discharged, this arrangement having been credited to Pupin. It also contains a pointed reply from the latter stating that such an arrangement was not a new invention.

The *Elec. Rev.*, Feb. 19, suggests the words radiograph and radiography. The *West. Elec.*, Feb. 22, contains an article by Prof. Stine on "The New Photography" in which he gives a brief summary of the subject; he suggests the term sciography.

The same journal states that, according to a London correspondent, the Vienna Museum contains as one of its chief treasures an Egyptian mummy, which on the outside resembles a human body, but it is too rare a specimen to unwind the bandages in order to find what the contents were, and a shadowgraph was therefore taken which plainly reveals the skeleton of a large bird.

A portrait of Prof. Roentgen is published in the *Sc. Amer.* and *West. Elec.*, Feb. 22.

Radiant Matter. CROOKES. *Elec. Eng.*, Feb. 19.—A reprint of his British Association paper, read in 1879.

ELECTRO-CHEMISTRY AND BATTERIES.

Persulphuric Acid in the Lead Accumulator. ELBS and SCHOENHERR. *Zeit. f. Electrochem.*, Feb. 5.—They reply to the criticism of Dr. Schoop, which was abstracted in the *Digest*, Nov. 9, substantiating their former views; they consider that the matter has been sufficiently clearly investigated, and that no further tests are necessary; they repeat that in the reaction on which the lead accumulator depends, the persulphuric acid does not take a significant part; it assists in the destruction of the lead frames of the plates, a matter which they never questioned; their objections to the Darrieus theory do not apply to the whole of it, but only to that part which refers to the peroxide plates.

Battery Carbons. BARNETT. Lond. *Elec. Rev.*, Feb. 7.—The tabulated results of experiments with a plain rod, a platinized rod and a "Velvo" rod with reference to their polarization; the results are very much in favor of the latter. (The "Velvo" carbon, as was described in these columns some time ago, consists of a carbon rod or plate, the surface of which is covered with a substance like carbonized velvet, the object of which is to produce a great surface.)

Caustic Soda and Bleach. Lond. *Elec. Eng.*, Feb. 7. A brief description of the works at Snodland in which the Holland and Richardson process is used.—The present output is about 100 tons of 35 per cent. bleaching powder, and 60 tons of 70 per cent. white caustic soda per week, from 10 tons of common salt. The business is increasing so steadily that arrangements have been made and the machinery ordered to treble the present production; the process is said to be highly satisfactory.

Electrolytic Amalgams. ANDREOLI. *L'Elec.*, Feb. 8.—He considers that the use of electrolytic amalgams has for some reason not received the attention it ought to have; these amalgams are easy to produce, cost very little, and could be of great service in the industries; aluminum may be considered as the only one of the precious metals that could not easily be made to form an amalgam; he discusses briefly the applications of alkaline amalgams.

Nature of Chemical Change and the Conditions Which Determine It. ARMSTRONG. Lond. *Elec.*, Feb. 8.—The first part of a long abstract of an address before the London Chemical Society. The same journal contains an editorial discussion of this, and a recent paper of J. J. Thomson.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Resistance Boxes. STRECKER. *Elek. Zeit.*, Feb. 6.—An illustrated paper describing an improved form of resistance box and Wheatstone bridge, which is claimed to have a number of advantages over the usual form of plug resistances. He enumerates the objections to the plug resistances, all of which are already well-known. Among the advantages of the present form is that all the surfaces are on the same plane and are all parallel to the surface of the box, so that the expansion of the hard rubber will not affect the contact; they are easily made, and kept clean; the contact is made by means of a pivoted horizontal piece, the ends of which slide over the contact blocks, these pieces being turned by a handle, for changing the resistance; the pivot of this piece is not in circuit, there being segmental blocks under both ends and this is claimed to be a great improvement over those in which the pivot forms one of the contacts; the form which is illustrated was devised and has been used by the telegraph department of the German Government. Each set of resistances consists of five separate units and another single coil of five units; the single units are connected between the first five successive blocks and have branch connections, in the same order, to the second five blocks; the five-unit coil lies in an opening in the middle of the semicircular piece which is opposite to the 10 blocks, which latter form the other half of that circle; in this way all numbers from 1 to 10 may be made up by simply turning the switch handle; the only objection to this arrangement is that in passing from four to five units there is a momentary short-circuit of all those resistances.

This is followed by a paper of Dr. Raps, describing and illustrating a convenient form of resistance box made by Siemens & Halske. In a circular box there are four sets of resistances, one each for tens, hundreds, thousands and ten thousands, each divided into ten equal units the blocks for which form quadrants, each having its own pivoted contact arm; the contact arm differs from that in the above in that the pivot is in circuit; for smaller resistances there is a spirally wound wire encircling the upper edge of the box, and over this a contact arm, pivoted at the centre, moves. He also describes and illustrates a standard resistance of the newest form as made by that firm.

The Use of Carbon as a Resistance Material. Zeit. f. Elek., Feb. 1.—A short article describing a special form of carbon resistance; the advantages of using carbon are pointed out; the specific resistance is given as 0.0075 ohm-centimetres, that is, the resistance of a rod 1 metre long and 1 sq. mm in cross-section is 75 ohms at 0° C.; the temperature coefficient is 0.00052; a table giving the values of other materials show that the resistance of a rod of carbon is 79 times that of an alloy of manganese and copper, which is now used as the material of highest specific resistance; the "specific current density" of carbon is very small for arc light carbons, and with a mean diameter of 8 mm it is about 0.125 ampere for a temperature not exceeding 100° C.; various curves for the resistance of carbon are given; it is said to have a very high heat-radiating property and therefore the maximum cross-section should be kept as small as possible; for practical purposes the ordinary arc light carbons are most convenient; in the apparatus described, a number of them are held parallel to each other by two end plates of slates which allow them to expand; they are connected in series, and are provided with conducting blocks which may be moved along their length and which connect two neighboring carbons together; neither the description nor the illustration is quite clear.

Non-Inductive Resistance for Testing. FLEMING. Lond. *Elec.*, Feb. 7.—A brief, illustrated description of the apparatus devised by him and described in his recent lecture; it is used for testing purposes, especially for taking off any required current from 100-volt mains. It consists of two glass or porcelain discs having a number of pins or lugs near their periphery; they are fixed opposite to each other on the ends of a long brass rod, one being securely fastened and the other loose, with a spring tending to push it away from the other; one or more bare, fine wires of some resistance material are then wound backward and forward longitudinally and parallel to the centre rod, the wires passing over the pins or lugs; the ends terminate in suitable copper wires. Such resistances have a small self-induction, and yet a very large surface for ventilation; he calls it a cage, each one constituting a unit, a useful size being a resistance of 100 ohms capable of carrying 1 ampere safely; 10 such units enable one to draw from a 100-volt circuit any required current from 0.1 to 10 amperes. These resistances are very easily repaired and the insulation is extremely high.

Standard of Light. DIBDIN. Lond. *Elec. Eng.*, Feb. 7.—The first part of the reprint of a Society of Arts paper, in which he discusses the subject of various standards with reference to their application and adoption in Great Britain as standards for measuring gas. (His pentane Argand standard is the one that has been chosen by the British Board of Trade as a substitute for standard candle in daily work.)

Effect of Temperature and Electrification on the Insulation of Gutta-percha. ZIELINSKI. *Elek. Zeit.*, Feb. 6.—The conclusion of his long article.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Horizontal Switchboards. WIETLISBACH. *Elek. Zeit.*, Feb. 6.—A discussion of the relative advantages of vertical and horizontal switchboards for large telephone stations, with special references to the advantages of the Law system, used in this country. The switchboard in a station is such an expensive part of the plant that the proper selection becomes very important; he discusses, in detail, the relative merits of the two kinds, and concludes from calculations based on existing stations that the first cost of both systems is very nearly the same; under average circumstances, one girl can serve 100 subscribers on a vertical board, while on a horizontal one the maximum is 70; capitalizing this difference, taking into account the reserve also, he finds that it is almost enough to pay for the whole installation; he states that he fails to see wherein the advantages of the horizontal board lie; he believes that through a misunderstanding, the advantages of the Law system have been thought to be due to the horizontal board, while he considers that they consist in some of the details; the Law system would retain its chief advantages even with a vertical board; a disadvantage lies in the special calling circuit,

and it is adapted exclusively for densely populated cities with relatively short lines; the cost of operation is, in general, more expensive, and is therefore applicable only where the number of calls is high and where the subscribers are willing to pay more for a quick service.

Military Cable Telegraph. Lond. *Elec.*, Feb. 7.—A brief mention of the new system proposed by Mr. Snell, in which special 20-knot cruisers fitted with cable laying apparatus are to accompany each British squadron when on the warpath, and in this way the commanders of these squadrons can be kept in communication with the mainland; "whether to the benefit of our naval operations may be doubted."

MISCELLANEOUS.

Conductivity of Aluminum. Lord Kelvin. Lond. *Elec. Rev.*, Feb. 7.—A brief note correcting the statement made by Addenbrooke (see *Digest* last week). He found a bad error in his test which were referred to, and now finds that his measurements give results substantially agreeing with those already published in most of the recent text-books for approximately pure aluminum; no specific data is given.

Pressure and Conductivity. Tammann. *Elec. Eng.*, Feb. 19.—A reprint in abstract of the article mentioned in the *Digest*, Dec. 7.

Scientific Materialism. Ostwald. *Science*, Feb. 14; reprinted in abstract in *Elty*, Feb. 19.—A discussion of the subject of matter and motion.

Carborundum. Fitzgerald. *Cassier's Mag.*, February.—A short article describing what the material is and how it is made.

Biographical. Elec. Jour., Feb. 1.—A full-page portrait of Sir William Siemens; a portrait of Jacobi appears in the issue of Feb. 15.

New Book.

Dynamo-Electric Machinery. By Silvanus P. Thompson. New York: Spon & Chamberlain; 5th edition; 835 pages, 520 illustrations, 19 plates. Price, $5.50.

This, the fifth edition of Prof. Thompson's widely-known text book, has been completely revised and greatly improved. The section relating to the magnetic properties of iron has been considerably condensed, much of the matter having been transferred to the same author's work, "The Electromagnet." The chapter on hysteresis has, however, been enlarged and thoroughly modernized, as has that portion of the book devoted to armature winding and core construction. The chapter on commutators, brushes and brush-holders, is apparently overlooked, none of the methods of construction in universal use being mentioned.

The chapters devoted to elements of dynamo design and examples of modern dynamos have been elaborated and made more instructive than they were in the fourth edition, and armature reaction is discussed at length and in the light of the most recent developments.

The portion of the book relating to arc lighting dynamos is conspicuously incomplete, some of the latest types of successful American machines being omitted entirely, and others merely mentioned. This is more than compensated, however, by the admirable improvement in the chapters relating to alternators, alternating-current motors, transformers and rotary converters; these have been entirely re-written and are now up to date. New appendices have been added upon the subjects of electro-metallurgy and forms of specifications for apparatus.

While Prof. Thompson has not adopted the Lodge-Ayrton magnetic units, he has the following to say of the American provisional names for the C. G. S. magnetic units:

"It should be remarked that the American Institute of Electrical Engineers has proposed the name *weber*, to denote one line instead of 10^8 lines; and that it has proposed the name *gilbert* for the unit now called the gauss, while it has, unfortunately, proposed the term *gauss* as the unit of flux-density to mean a density of one line per square centimetre."

As the American Institute of Electrical Engineers had adopted the names referred to more than a year before the English "jingo" units were proposed, and as they had already passed largely into use in this country before the B. A. took action on the latter, the tone of this comment is somewhat remarkable. If the word "unfortunately" has any application at all in this connection, it is with respect to the employment as the name of the unit M. M. F. in the "jingo" system of the word *gauss*, which was proposed by Prof. Thompson himself in 1884, and earlier by Sir William Thomson, as the name of flux-density, and is thus used in the American system.

As it stands, the book, though by no means an ideal one, is to designers the most complete and valuable work published in any language, and is an excellent one for students of the principles governing the working of electro-dynamic machinery.

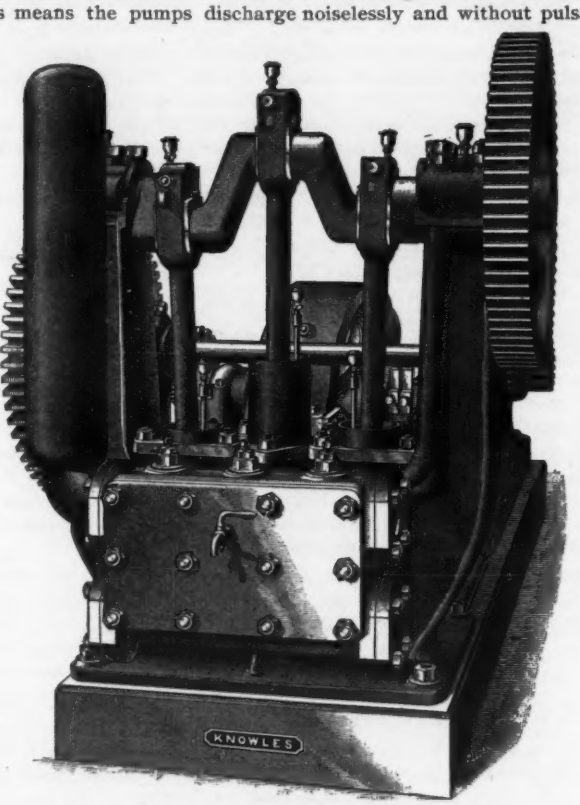
A Mathematical Problem.

A prize problem which appeared in the advertising columns of this journal last week has, it seems, created considerable interest. The problem is not at all of the obvious kind, and some who have attempted its solution are inclined, we learn, to doubt whether the answer is a practicable one; that is, whether the number of switches given by the solution—if there is a solution—could well be packed in a shipping case of usual size.

Having been fortunate enough to arrive at a solution of the problem, we can set doubts at rest on both of these points; the problem is a legitimate mathematical one, and the number given by the solution is not such as to require a packing case beyond commercial dimensions. We will add that no claim will be made for the prize on our solution, which will not be divulged.

Electric Power Pumps.

Perhaps the most uneconomical piece of steam apparatus in existence is the steam pump. It is undoubtedly a fact that in spite of the numerous efficiency losses in the generation of electrical energy, it is more economical to run a pump by means of an electric motor than to run one of the direct-acting steam pumps so generally used in power stations. The Knowles Company, of Brooklyn, has recognized the practical bearing of this consideration, and is now making an extensive line of electric pumps; we give an illustration of one of its triplex electric power pumps, which shows the general trend of the new practice. The design is compact, and the arrangement of parts facilitates ready inspection. The three-throw pattern has a decided advantage in that the cranks are set at angles which bring the plungers continuously upon the water column without the shock due to reversing of the stroke, and by this means the pumps discharge noiselessly and without pulsation.



Electrically-Driven Pump.

The gears are cut and therefore run quietly, and the shafts work in babbitted boxes. The plungers are packed from the outside, so that any leakage may be detected. The connecting rods are made with adjustable metal boxes and keys. The lower ends of the rod are fitted with combination metal bushings held in the plungers by steel pins. Both suction and discharge valves can be examined by removing one cover. The amount of coal which is used in pumping the condensation from the condensers and feeding the boilers is very small in an ordinary railway power station, but the facility with which the manipulation of these electric pumps can be conducted from distant points is a very strong argument in their favor.

A New Valve Gear.

The new valve actuating motion, illustrated on the following page, has within the past year been put upon the market by the Fitchburg Steam Engine Company, of Fitchburg, Mass. It differs considerably from other forms of steam valve gears, and is claimed to be a complete equivalent of the complex releasing type of valve gear without the objectionable features of the latter, such as the noisy clicking of catching and tripping devices, the hissing of dash-pots, and the many small pins and joints to be kept in order. The former construction of wrist-plate motion, with its double rods and sleeve, has been superseded by a simple cam wrist-plate with positive action, this making it reliable under all conditions, and with absolute control of the valve movement.

The cut shows clearly the action of the new gear. The pin or cam roller actuating the valve on the crank end of the cylinder is shown as having completed its concentric path in the slot of the cam, during which the roller has imparted no motion to the cam, which is attached directly to the valve rod. Owing to the form of the remainder of the cam

the valve is started gradually and quietly till its edge has reached the edge of the port, when it suddenly opens the latter, giving a clean and sharp admission, and holding it until the point of cut-off, and closing the port as suddenly as it was opened. The quickness of travel, being twice that in the ordinary direct connection, is due to the manner in which the wrist crank which moves the cam is keyed to its actuating shaft with relation to the crank by which motion is given the shaft, a result being thus obtained equaling that of the best forms of releasing valve gear. The actuating mechanism is simple yet effective, requiring almost no attention, and, being positive, it admits of a great range in number of revolutions—if necessary, to as high as 200 revolutions or as low as 60 revolutions per minute—with equally good results and no noise.

The friction of the moving parts being practically nothing, the work imposed on the cams is very slight, no wear being discoverable after a year's constant use. The valves are double ported and equivalent to the many ported gridiron valves and, because of the special design of the cam, move only just far enough to open the ports their full width with lap enough to ensure absolute closure against admission of steam. The valves are perfectly balanced, reducing friction to a minimum, and require no power to move them, as they are always in equilibrium.

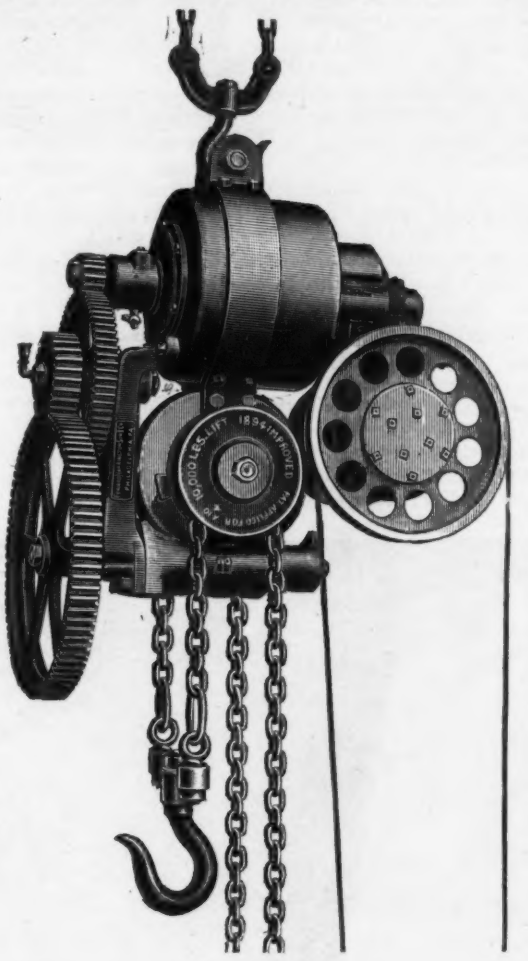
The valves being independent, move one at a time. This, with the fact that the valves travel only half as far as formerly, is an advantage over the former wrist-plate, which moved both valves at the same time, as it reduces the work upon the governor to such an extent as to relieve it of all duty except that of regulation. The governor is a part of the engine keyed directly to the crank-shaft, and cannot become detached. There is no belt to break and no relying on insufficient "automatic stops," which are often used with the expectation of preventing the engine from running away under extreme changes of load. The governor in action responds promptly to each variation of load, however great or abrupt, and keeps the speed constant even when carrying the excessively varying load of an electric railway or a rolling mill. This improved cam-valve motion can be used, if desired, to drive a gridiron flat valve with equal satisfaction.

The engine fulfils the conditions of economy to be looked for in an engine, namely, small clearances; free steam openings from steam chest to cylinder, to allow full boiler pressure to enter the cylinder up to the point of cut-off; free exhaust, allowing no back pressure through any fault of engine; rapid motion of the valve at the point of opening and cut off; close regulation of speed, and the least possible friction in the valves and moving parts of the engine.

Hoist and Electric Motor Combined.

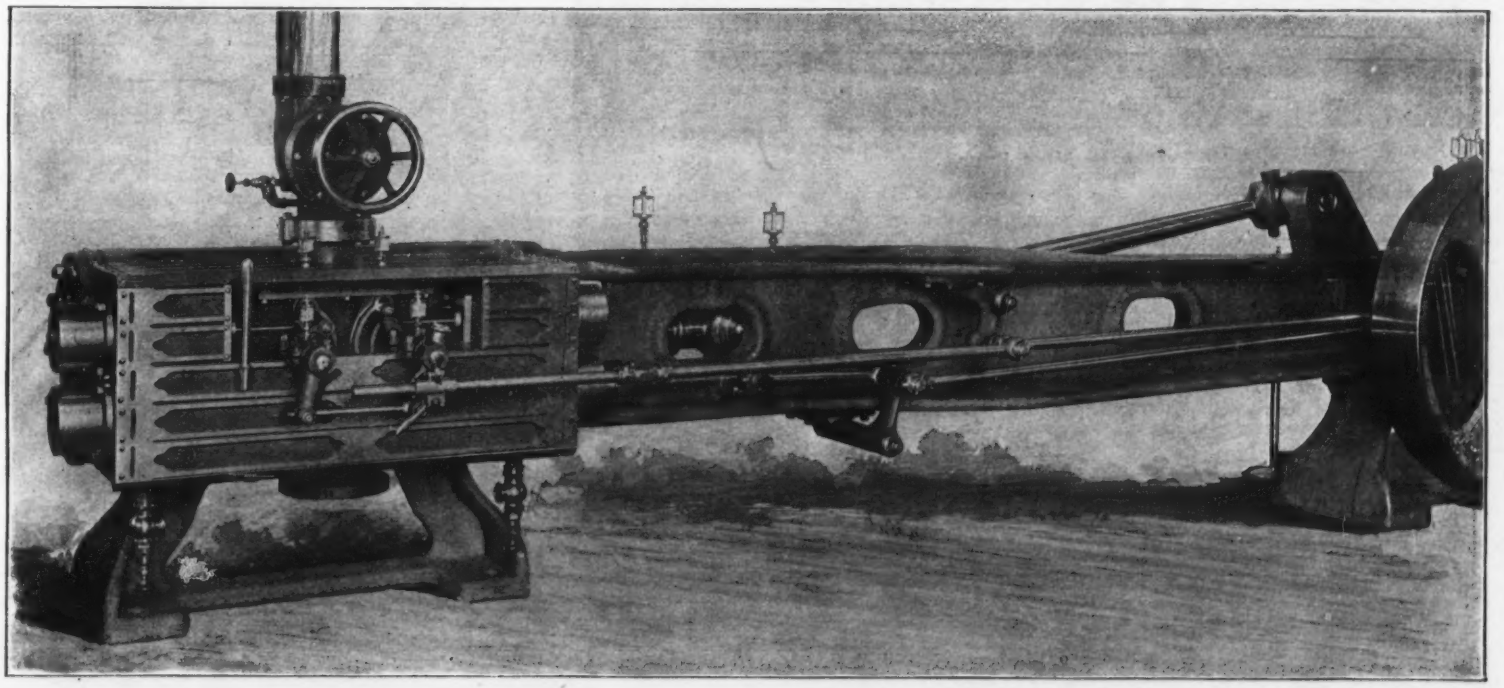
While the electric crane has a large and increasing field of usefulness, only a limited area comes under its control; on the other hand, the electric portable hoist makes it possible to apply electric power in hundreds of places where the crane cannot be used.

Ten thousand pounds can be lifted with great ease, with a saving of three quarters of the labor, while the gain in time is 5 to 1; that is, 10,000 pounds can be raised at a maximum speed of 5½ feet, and lowered at the rate of 10 feet per minute. Smaller loads can be raised faster.



ELECTRIC HOIST.

By means of a controller operated by the ropes, shown on the right of the cut, the operator can vary the speed as he may desire, within limits. By this controller also the action of the motor is started, reversed or stopped. The motor shown in the cut, which is of the Storey design, is compact in form, multipolar, iron-clad and entirely enclosed, making it dust-proof, fire-proof and moisture-proof.



A NEW VALVE GEAR.

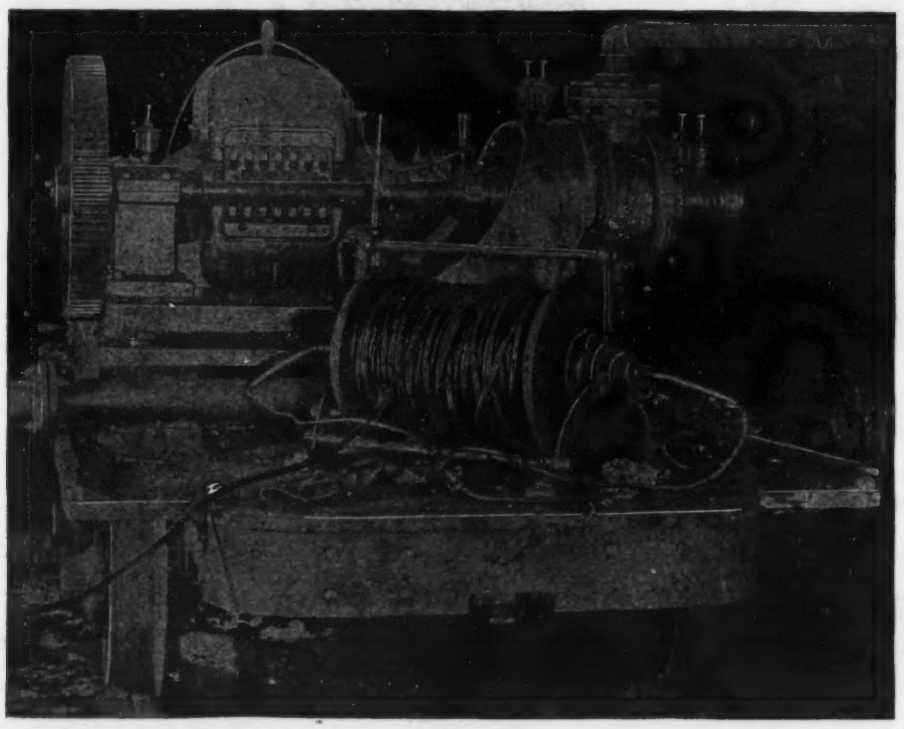
With the combination we illustrate, made by Edwin Harrington, Son & Company, Philadelphia, Pa., it is claimed there is a saving of two thirds the labor required to lift 6000 or 8000 pounds by the hand-power hoist

Ice Cutting by Electricity.

A novel piece of apparatus was tried at Concord, N. H., last week, consisting of an electric ice-cutting machine, the invention of Woodsum Brothers, Sunapee, N. H. The apparatus resembles a mowing machine with a sled in front of the wheels. Directly under the seat is a 5-hp, three-phase, 110-volt induction motor, which drives, by means of a belt, a circular saw located in the forward part of the machine, and also, by means of friction wheels, the mowing machine wheels which propel the machine. A guide runs in the last groove cut, which guides the machine and makes the cuts parallel. The current comes through flexible conductors, which drag over the ice. In the test at Concord current was supplied from the station of the Concord Land & Water Power Company. The whole apparatus weighs only about the same as an ordinary horse, and the operator in his mowing machine seat, by means of levers, can make the machine go forward and back, and can vary the depth of the cut from 1 inch to 9 inches. The saw cuts a groove three eighths inch wide. The test was successful from the start, and a speed was attained of 100 feet in one minute, cutting a groove 9 inches deep.

A New Electric Mine Pump.

The use of electricity in mines and its application to all operations of mining is making steady advances. The flexibility of the electric system lends itself more particularly to the requirements for power in mining than in any other field. Many mines that have started in a small way with an electrical equipment for simply operating coal-cutting machines have added from time to time to their plant to enable them to operate all the machinery used in their mines from the same source of power.



Jeffrey Mine Pump.

The advantages of an electrical system of transmission of power is nowhere so evident as in pumping machinery, such as is used in the bituminous drift coal mines. The electric mine pump illustrated is one furnished by the Jeffrey Manufacturing Company, of Columbus, O., for the Crozer Coal & Coke Company, at Elkhorn, W. Va. The pump is of the rotary type, fitted with bronze throughout where the water comes in contact with the metal. It is operated by a 10 horse-power, slow-speed, iron-clad motor. The pump is handling 150 gallons of water per minute and delivering it through 1500 feet of four-inch pipe, raising it, on an average, 25 feet. The whole equipment is mounted on a substantial wooden truck and is moved from place to place in the mine, as the water collects in the dips. This company has in operation at this mine one of the largest electric mining machine plants installed.

Electric Power Paper Mill.

The Cliff Paper Company, of Niagara Falls, is building a new power-house, in which it will generate electricity for use in its paper mill. A pulp mill of this company is driven by Leffel wheels at the water's edge, below the Falls, and a paper mill on the top of the high cliff, is also driven by turbines, thus securing a double service from the water. This double use of water is quite an innovation, and has brought discredit upon the saying that "The mill will never grind with the water that is passed." This progressive company is about to take another step to practice economy, and it will adopt electricity to succeed steam in running its paper machines. When this proposed electric plant is installed, it will displace three steam engines of over 200 horse-power. Preparatory to the adoption of electricity a stone power-house will be built, 20 x 30 feet in size, close to the pulp mill. The penstock leading to the pulp mill will be tapped, and a portion of the water diverted to run a 250 horse-power James Leffel turbine, to which will be attached two 125 horse-power generators. The head water on this turbine will be 125 feet. At the top of the cliff will be two electric motors of 100 horse-power each, attached to each of the paper machines; besides, there will be two motors of 5 horse-power each, to furnish power for the small machinery about the mill.

The O'Connor Electric Railway System.

Patents have been granted by the United States to Mr. Thomas F. O'Connor, one of the experts of the Standard Underground Cable Company, for a novel conduit railway system. The system consists broadly of a number of cars, each provided with an individual current-conductor, one end of which is attached to the car and the other end to an underground reel, the conductor being insulated along its length. The reels are all electrically connected to the source of power. For long lines it is proposed to divide the road into sections of convenient length, with a vault, containing conductor reels, at the beginning of each section, the plan being for each car to pick up the end of a new conductor when it enters a section, leaving the one previously in use to be rewound on its reel, in readiness for another car. Fig. 2 shows a section of such a road. Fig. 1 shows a cross-section of one form of conduit which the inventor proposes to use, and in which are provided a number of rollers arranged in different horizontal planes, each set occupying one plane to be used for the support of one cable. An arm projects from the bottom of the car down into the conduit, and is provided with a supplementary arm hinged to the lower end so that it can be adjusted to deposit the cable on any desired set of rollers as it is unwound from the reel. It is proposed to operate the reels by electric motors in rewinding the cables, and to have an attendant in each vault to look out for changing the cables on the cars and rewinding them as they are released at the far end of the section. It is also proposed to provide a suitable annunciator system between the several vaults, by means of which the attendants can notify each other when a cable is ready to be rewound upon its reel.

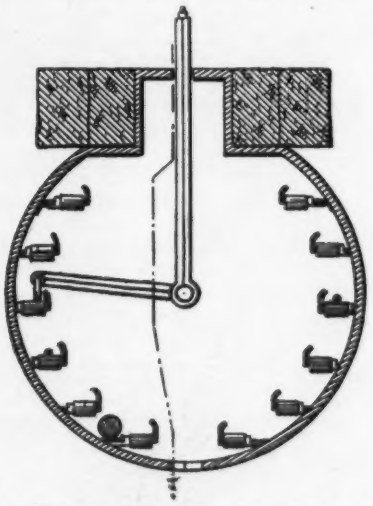


Fig 1.—O'Connor Conduit.

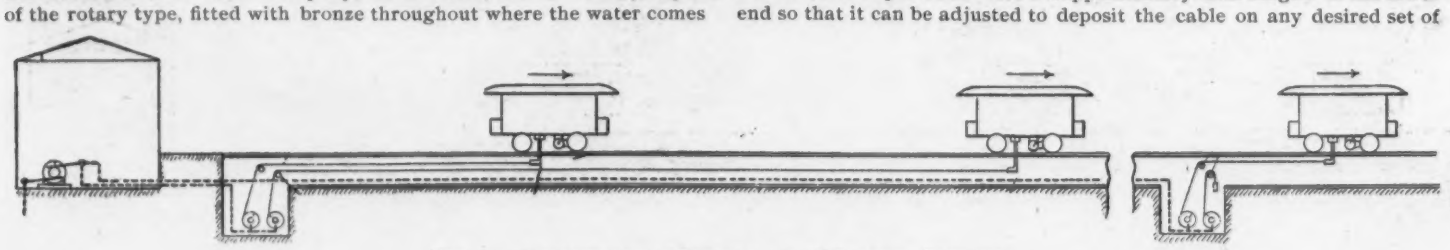


Fig. 2.—Longitudinal Section of O'Connor Conduit.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Feb. 21, 1895.

AMERICAN BELL closed strong on Monday, and gave promise of a mild boom; on tolerably sharp trading Tuesday, however, the stock dropped two points. Later on the decline was recovered, and the price remained at 204 until to-day, when it again "sold down." There are many conflicting stories in circulation concerning the Bell Company's intentions as to telegraph service after the expiration of the Western Union contract in November, and these stories apparently had some effect upon the stock.

WESTINGHOUSE ELECTRIC.—There have been some superfluous efforts made this week by bears on Westinghouse stocks to explain an imaginary sharp decline in those stocks; as they are not quoted on the New York exchange floor, but in Boston, and as they have remained quiet and practically unchanged during the week, the reason for the "explanations" is a little obscure.

COLUMBUS STREET RAILWAY stock has been the strongest feature in the traction list during the week. The matter of the Columbus Central Railway's application to operate its cars on a portion of High Street has been settled temporarily at least, and to this is attributed the advance in Columbus Street Railway stock.

BUFFALO RAILWAY stock on limited offerings has declined somewhat, but the bonds, both Consols and Crosstowns, are strong. The regular quarterly dividend of 1 per cent. has been declared, payable on March 10.

WORCESTER TRACTION.—On reports that the accumulated dividend of 3 per cent. will be paid during the year, Worcester Traction securities continue strong at fractionally higher quotations. Sales of the preferred are reported around 87, while the common is in demand at 15.

BROOKLYN RAPID TRANSIT stock continues to hold its own, but the bonds on rather free offerings have declined somewhat.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	93	96
" " " Brooklyn	100	110	115
" " " Boston	100	145	150
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	29	30
Electric Storage, pref	100	..	..
General Electric	100	31	31½
General Electric, pref	100	60	62
Westinghouse Consolidated, com	50	30	31
" " pref	50	54	54½
BONDS.			
Edison Electric Ill., New York	105	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	..	90¼
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	..	2.2
American District Telegraph	100	33	40
American Telegraph & Cable	100	92	94
Central & South American Telegraph	100	117	120
Commercial Cables	100	150	..
Erie Telephone	100	60¾	61
New England Telephone	100	89½	90
Postal Telegraph-Cable	100	85	86
Western Union Telegraph	100	86⅛	86¼
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	17⅞	18⅛
Brooklyn Rapid Transit		22⅜	23½
Brooklyn Traction	100	7½	9½
" " pref	100	49	52
Buffalo St. Ry	100	71	73
Cleveland Electric Ry	100	..	..
Columbus St. Ry	100	49	50
Hestonville	100	49	50
" pref		61	63
New Orleans Traction	100	17	19
" " pref	100	65	68
North Shore Traction	100	30	33
" " pref	100	79	82
Rochester St. Ry	..	27	35
Steinway, Ry	..	49	..
Union Railway (Huckleberry)		99	102
Union Traction, rcts $5 pd	..	12¼	12⅜
West End, Boston	100	68	68½
" " pref	100	89	89½
Worcester Traction	100	14	16
" " pref	100	85	88
BONDS.			
Brooklyn Rapid Transit 5s. 1945	100	81	83
Buffalo St. Ry. 1st con. 5s	100	104	107
Cleveland Elec. Ry. 1st mtge 5s	100	101	103⅛
*Columbus St. Ry. 1st 5s	100	95	100
Rochester St. Ry. 1st 5s	100	98	101
Union Railway (Huckleberry) 1st mtge 5s		103	105½
*Westchester Electric 1st mtge 5s	100	100	102

* With accrued interest.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Feb. 24, 1896.

CHAS. A. SCHIEREN & CO., 45 Ferry Street, have placed their Dixie tannery at Bristol, Tenn., in full running order, and it is now turning out a very superior quality of leather. The slow process of tanning with pure oak bark is used, thus insuring the high grade of product necessary for belting.

THE AUTOMATIC TELEPHONE COMPANY, of Brooklyn, N. Y., has elected the following officers: H. N. Whitney, president; J. G. Dorrance, vice-president; W. B. Chase, treasurer, and E. F. De Freece, secretary. The Executive Committee consists of the president, vice-president, treasurer and J. W. Hinckley and S. B. Dutcher. Secretary De Freece says that the company has already a number of subscribers and hopes in a few weeks to begin work on its plant.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., Feb. 21, 1896.

NEW HAVEN, CONN.—Judge Townsend, in the United States District Court, has given a decision in favor of the Bryant Electric Company in the suit of O. S. Black, alleging infringement of a switch.

MR. J. S. GIBBS, of the Gibbs Electric Manufacturing Company, Hartford, Conn., of switch and socket fame, is about ready to introduce an improved and "up to date" line of these manufactures. That success will attend him is the hope and belief of his large circle of friends.

MR. J. J. GATES, of Hartford, Conn., who is so well known as to require no special mention, will soon enter into business for himself, information which will be pleasant to his many friends. Mr. Gates recently purchased from the receiver 78,000 Novak lamps, and disposed of them at good figures in less than three weeks, sharp competition to the contrary notwithstanding.

THE ELEKTRON MANUFACTURING COMPANY, Springfield, Mass., is exceptionally busy at present and has been for some time. While electric elevators form a large measure of its manufacture, a good demand for Perret motors is evidenced, and the company is kept busy in the line of special electrical machinery. Mr. E. H. Cutler, manager, has just started for a Western trip, and we had the pleasure of shaking his hand, and having a brief talk with him at the train the evening he left.

THE EDDY ELECTRIC MANUFACTURING COMPANY, of Windsor, Conn., held its annual meeting on Tuesday, Feb. 18. The report for the year showed business with the Eddy Company to be in a most prosperous condition. The orders now on hand will keep the factory busy for some time to come, while Secretary Newton and Sales Agent Baird say the outlook for the future was never more promising. It is a pleasure to chronicle the success of such an establishment when that success is the outcome of the high grade of its goods combined with aggressively conservative management. Inventor Eddy still gives his personal attention to the manufactures of the company, efficiently assisted by Superintendent Corson.

THE NEW ENGLAND ELECTRICAL TRADE ASSOCIATION has finally been formed, and the following temporary officers chosen: President, Frank Ridlon; vice-president, Philip M. Reynolds; treasurer, D. A. Andrews, Jr.; executive committee, D. A. Andrews, Jr., P. M. Reynolds, Arthur Drew, Henry B. Cram and C. C. Allen. The firms represented were the Pettingill-Andrews Company, Bibber, White & Co., Anchor Electric Company, Frank Ridlon Company, Boston Electric Company, Electric Gas Lighting Company, Wheeler Reflector Company, J. W. Poole, Bernstein Electric Company, and the New England Electric Supply Company. The meeting for the election of officers will probably be held on the third Friday of March at Young's Hotel.

THE SPRINGFIELD (MASS.) STREET RAILWAY COMPANY is a thoroughly representative electric railway system both in construction and management. Mr. John Ohlmsted is the president and Mr. Austin E. Smith the general manager, and both have been connected with the company since "the days of the horse." It is evident that good business forethought has contributed very largely to the realization of the present perfection of this system. From six different lines and a mileage of 18 miles the system has grown under electricity to 12 lines and a mileage of 44 miles, tapping all parts of the city and suburbs in a manner most satisfactory to the residents and with profit to the company. A noteworthy policy of the company is the consideration of the working force, with which it has never had any trouble, because it has always accorded them fair treatment and paid them living wages. This line was the third in the country to adopt electricity and its power house is most thorough and complete.

THE PERKINS ELECTRIC SWITCH MANUFACTURING COMPANY, Hartford, Conn., held its annual meeting Feb. 12, and in the report made for the year 1895 a decidedly favorable showing of business was manifest, with good reasonable profit, notwithstanding the heavy expenses incident to the new factory. The following officers and directors were elected for the ensuing

year: President, C. G. Perkins; vice-president, P. H. Woodward; secretary and treasurer, E. W. Hooker; directors, the above named, and J. M. Allen, E. C. Frisbie, Robt. A. Griffin and Chas. P. Whiting, all strong and representative business men of Hartford and vicinity. Aside from its standard manufacture of incandescent lamps, Waterhouse arc-lamps switches, sockets, etc., the company has arranged to make Crookes tubes, with the highest possible vacuum, besides which it is also prepared to manufacture to order, and promptly, tubes of any special form. President Perkins is an old-timer in the electrical business, and it was a pleasure to renew his acquaintance on a recent business trip and to go with him through his admirably arranged factory. Secretary Hooper has had most of his business training in another line, but is so alert and broad-gauge that it is difficult to tell that he has not always been identified with electricity.

THE JEWELL BELTING COMPANY, of Hartford, Conn., has reached the half century mark of its successful career, and is one of the best known and most highly respected establishments of its kind. The mature business experience of the Messrs. Jewell, supplemented by the progressive ideas of the active manager, Mr. Charles E. Newton, continue to keep the Jewell Belting Company in the front rank. Mr. Newton has grown up with the company, and everybody admires and esteems him for his many excellent qualities. The factory of the company is most complete in its details. It was our pleasure recently to visit it with Mr. Newton, and to notice the truly remarkable gradations of belting manufacture, from the one-half inch pin belt to the huge 79-inch four-ply belt used in connection with electrical work. The promptness with which one of these enormous belts may be manufactured, when, as in the case of the Jewell Company, there is a large stock of well-seasoned leather on hand, was recently well illustrated. The Rochester (N. Y.) electric railway plant early on a Sunday morning ordered a belt to take the place of one destroyed by fire. Although the belt had to be made, it was completed during the day, and installed into service in the plant by 9.30 o'clock the following morning. The word "fail" is not in Mr. Newton's vocabulary. The company has just finished a 69-inch three-ply belt for the Norwich (Conn.) Electric Railway Company.

THE CHAPMAN VALVE MANUFACTURING COMPANY, of Indian Orchard, Mass., is unquestionably one of the largest and most thriving of the manufacturing establishments of this country. Its plant is mammoth in buildings and space, and throughout the depression in business the force was never cut down or the hours of work curtailed. The Chapman valves for steam, water, gas, ammonia, fire hydrants, etc., are favorably known and in general use, and no branch of industry has been more quick to recognize their value than the electric. A recent visit to this plant was an appreciated pleasure. Supt. Lorin Aldrich, who has been connected with the company since its establishment in 1874, explained the different processes of manufacture. It was also our good fortune to have a most interesting talk with Mr. Charles J. Goodwin, treasurer of the company, who likewise has been identified with the Chapman Valve Company since its inception. Mr. Goodwin says that the company was originally started principally with the idea of affording employment to village residents, and no one then imagined that it would ever grow to its present proportions, the immensity of which may be realized from the fact that a car load of iron castings is produced daily, while two car loads of copper are used up every month. By no means least of the pleasures incident to the visit was meeting Mr. Jas. D. Safford, president of the company, and one of the most prominent residents and business men of Springfield. Mr. Safford is also president of the City National Bank of Springfield, and from the investment standpoint his sound business judgment and progressive ideas have led him to interest himself in quite a number of electrical and kindred enterprises, notably the Springfield Electric Railway Company and the American Speaking Telephone Company, in both of which he is a director and valued adviser.

Western Notes.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., Feb. 19, 1896.

THE CHICAGO GENERAL GAS FIXTURE COMPANY is quite busy getting out a new and attractive catalogue.

MR. WALTER C. McKINLOCK, secretary of the Metropolitan Electric Company, has the sincere sympathy of all of the electrical fraternity at the death of his baby boy on Feb. 15.

THE SEBASTIAN LATHE COMPANY, Culbert Street, Cincinnati, reports that its business during the past year has increased to such an extent that on or about March 1 they will move into larger premises, the southern end of the Chesapeake & Ohio Yards, Covington.

MR. M. A. KNAPP, president for the Graphite Rheostat Company, has just returned from a very successful trip to the East, bringing more orders for his far-famed rheostat than he can well fill in many months. In fact, the demand for this rheostat is greater to-day than his factory can handle.

THE AMERICAN ELECTRIC MANUFACTURING COMPANY, of St. Louis, is rapidly disposing of its old stock of lamps at low prices, and is now turning its attention to the new incandescent lamp that is showing great results. Very shortly, it expects to be in a position to run its factory at its full capacity.

THE METROPOLITAN ELECTRIC COMPANY is putting on the market a double-coil filament incandescent lamp for street car use. This lamp is found to give unusual satisfaction for this class of work as it resists jarring, the filament will not break, and the lamp is long lived without any appreciable blackening effect.

COL. BOOKER, Superintendent for the Phœnix Carbon Manufacturing Company, of St. Louis, was in Chicago several days this week, and judging from the smile carried on his familar countenance, one would naturally suppose that his many pockets were filled with orders. The Colonel omitted to say in which direction he was going.

THE NOWOTNY ELECTRIC COMPANY, of Cincinnati, is now well established in its new quarters, 208 and 210 Lawrence Street. This company has made great strides of late, so much so that it has become necessary to increase its facilities for doing business. It has made a phenomenal success in the manufacture of its iron-clad dynamos and motors.

MR. GEORGE BAGNALL, who has filled the position of chief auditor for the Chicago General Fixture Company for the past four years, has lately taken the position of city salesman for this company. He is one of the most energetic, well-known young men in the business. Mr. C. O Baker, who formerly held the position, has been transferred to another department in the same company.

THE ELECTRIC APPLIANCE COMPANY has been pleasantly surprised at the way in which its wire sales have held up since the first of the year. It is usual to look for quite a falling off in this material after Jan. 1, but it states that the demand for both "O. K." weatherproof wire and "Paranite" rubber covered wire has been exceptionally good, much to the satisfaction of both the manufacturers and the Appliance Company.

MR. W. W. SARGENT, the superintendent of the Fitchburg & Leominster (Mass.) Street Railway Company, has been in Colorado for several months. His health gave way under the strain of hard work, and the company, realizing that he needed a radical change, made him a present of $1000 and gave him a year's vacation. In the favorable climate of Colorado Mr. Sargent has improved greatly in health. At the present time he is making a temporary stay in Los Angeles, Cal.

THE DAVIS & EGAN MACHINE TOOL COMPANY, Cincinnati, has just held its first directors' meeting, and elected the following officers: Chas. Davis, president; W. H. Burtner, vice-president, and P. B. Quillen, secretary. This company is one of the strongest in its particular line in the West, and are doing a very large export business. They have just shipped four 27-inch swing lathes to Coventry, England. In fact, they have shipped 160 large tools to England during the past year.

THE ELECTRIC CIRCLE, of St. Louis, Mo., gave its third annual banquet at the Union Station Cafe on February 8, at which 50 guests were present. Among those who responded were: Mr. G. E. Montgomery, of the Laclede Power Company; Mr. Gus Sachs, of the Western Electric Supply Company; Mr. George Bahret, of the Missouri Electric Light & Power Company, and Mr. A. R. Pike. At an election held Feb. 6 the following officers were elected. W. S. Merkle, of the Western Electric Supply Company, president; Tyler Surgeon, vice-president; George Bahret, secretary; T. S. Clark, treasurer and G. E. Montgomery, sergeant-at-arms. The entertainment committee for the ensuing year is composed of A. R. Pike and Gus Sachs.

General News.

New Incorporations.

THE HAWKEYE ELECTRIC COMPANY, Sioux City, Ia., capital stock, $10,000, has been formed by L. C. Nelson, H. O. Woodruff, A. W. Craik, Sioux City, for the purpose of operating electrical works.

THE SCHUYLKILL VALLEY ELECTRIC COMPANY, Reading, Pa., has been formed by D. B. Shepp, J. Hyde Clark, C. Henry Munn, Philadelphia, Pa., for the purpose of supplying electric light, heat and power. Capital stock, $5000.

THE BOWIE-LOVE COMPANY, Tacoma, Wash., capital stock, $1000, has been incorporated for the purpose of dealing in electrical goods, apparatus, machinery and supplies. Those interested are C. S. Bowie, M. M. Bowie and William J. Love.

THE NACOGDOCHES ELECTRIC LIGHT & POWER COMPANY, Nacogdoches, Tex, has been incorporated by R. C. Shindler, R. T. Shindler, and C. I. Shindler, of Nacogdoches, for the purpose of furnishing electric light. Capital stock, $10,000.

THE NATIONAL ELECTRIC HEATING COMPANY, Manchester, N. H., capital stock, $500,000, has been formed by W. E. Drew, D. B. Varney, E. P. Cornish, Manchester, N. H., for the purpose of manufacturing and selling electrical machinery, etc.

THE APPLETON ELECTRIC LIGHT & POWER COMPANY, Appleton, Wis., capital stock, $50,000, has been incorporated by A. L. Smith, J. S. Van Northwick, J. M. Baer, and L. E. Barnes, Appleton, for the purpose of furnishing electric light and power.

THE EUREKA COMMUTATOR BRUSH COMPANY, Milwaukee, Wis., has been formed for the purpose of manufacturing electrical appliances. Those interested are M. R. Hirsch, A. Sarkander and Ernst Sarkander, Milwaukee, Wis. Capital stock, $3000.

THE VALLEY ELECTRIC STREET RAILWAY COMPANY, Pittsburg, Pa., capital stock $16,500, has been formed by Robert H. Robinson, Monongahela, George D. Jenkins and Charles P. Rankin, for the purpose of building an electric street railway in Allegheny County, Pa.

THE MANISTEE TELEPHONE & ELECTRICAL MANUFACTURING COMPANY, Manistee, Mich., has been formed by John A. Nessey, Charles P. Wright, J. T. Mundy, Manistee, for the purpose of manufacturing and selling telephones and electrical supplies. Capital stock, $50,000.

THE MASON ELECTRICAL MANUFACTURING COMPANY, Philadelphia, Pa., has been incorporated by C. G. Camwell, William N. Read and William B. Mason, Philadelphia, Pa., for the purpose of manufacturing and selling electrical machinery and devices. Capital stock, $5000.

THE WATERLOO ELECTRIC LIGHT & POWER COMPANY, Waterloo, Ia, capital stock, $7000, has been formed by W. S. Isett, George R. Keller, W. H. Prescott, Jonas Miller, L. A. Riley and F. M. Orig, Waterloo, Ia., to construct, maintain and operate electric light and power plants.

THE BRIDGETON ELECTRIC COMPANY, Bridgeton, N. J., capital stock, $25,000, has been incorporated for the construction and maintenance of electric

plants. Those interested are John Riley, Schenectady, N. Y.; Henry M. Francis, Brooklyn, N. Y., and Edwin D. Mullen, Philadelphia, Pa.

THE BARRIET ARMATURE WINDING COMPANY, New York City, N. Y., has been incorporated by W. J. Quencer, A. B. Quencer, H. W. Shonnard and S. L. Barriet, New York City, for the purpose of manufacturing and repairing electrical machinery and apparatus. Capital stock, $10,000.

THE TURNEY ILLUMINATOR COMPANY, Chicago, Ill., has been organized by Nelson C. Cridley, Sterling E. Sharon and John B. Halpenny, to manufacture, buy and sell lamps, chandeliers, fuel fixtures, chemicals, electric and other appliances, machinery and implements. Capital stock, $100,000.

THE ROCKFORD GENERAL ELECTRIC COMPANY, Rockford, Ill., has been formed by Merwyn C. Wheaton, James Scribner, and Godfrey H. Atkin, for the purpose of producing and distributing electricity for light, heat and power, and doing a general electric lighting business. Capital stock, $50,000.

THE AMERICAN ELECTRIC COMPANY, Kittery, Maine, capital stock. $20,000, has been incorporated by E. H. Brock, Quincy, Mass.; William E. Thomas, Somerville, Mass., and Horace A. Pinkham, Quincy, Mass., for the purpose of manufacturing electric gas lighters and burners under letters patent.

THE ECUADOR GENERAL ELECTRIC COMPANY, Portland, Me., has been formed by Henry J. Ryan and W. B. Tobey, both of Pittsfield, Mass., and W. Bejarano, Guayaquil, Ecuador, South America, for the purpose of generating and distributing gas and electricity for light, heat and power. Capital stock, $100,000.

THE CENTRAL DEVELOPMENT COMPANY, San Francisco, Cal., capital stock, $25,000, has been formed for the purpose of constructing electric, steam and water plants and engaging in other enterprises. The promoters are H. B. Havens, Thomas S. Fish, William C. Stadtford, A. K. Durbrow, and J. Stadtford, Jr., San Francisco, Cal.

THE PLATTSBURG & ANSABLE TELEGRAPH COMPANY, Plattsburg, N. Y., has been incorporated with a capital stock of $1500, for the purpose of constructing, owning and using a line of electric telegraph within the limits of New York. Among those interested are George E. Lynch, Mary A. Lynch, Matthew J. O. Bryan, Plattsburg, N. Y.

THE BIRDSALL ELECTRIC MANUFACTURING COMPANY, New Rochelle, N. Y., capital stock, $10,000, has been incorporated to manufacture electrical novelties, implements and attachments, and to buy and sell electrical goods. The incorporators are Theodore Birdsall, New Rochelle, N. Y., and Samuel K. Johnson and Bryce Mars of New York City.

THE PACKARD ELECTRIC & MANUFACTURING COMPANY, Warren, O., has been incorporated by J. W. Packard, W. D. Packard, James P. Gilbert, J. W. Spangenberg and Robert E. Gorton, for the purpose of manufacturing, purchasing, renting and dealing in machinery, electrical appliances and supplies and furnishing electric light. Capital stock, $110,000.

THE SOUTH PLATTE RAILWAY & POWER COMPANY, Denver, Col., has been organized for the purpose of constructing a direct line of railway from Denver to Cripple Creek. The road will probably be operated by electricity. The promoters are S. T. Smith, J. E. Rockwell, Norman Allen, George F. Dayton and J. H. Dayton. Capital stock, $1,000,000.

THE DIRECT-CURRENT TRANSFORMER COMPANY, New York City, N. Y., has been organized to manufacture and sell electrical devices, and especially to make machinery for transmission of power. Those interested are Aldred Kennedy Warren, New York City; Henry B. Welch, New York City, and Frederick DaGoold, Brooklyn. Capital stock, $60,000.

THE CONTINENTAL MOTOR & TRACTION COMPANY, San Francisco, Cal, capital stock, $1,000,000, has been incorporated for the purpose of dealing in inventions and patents relating to electric and other systems of railway and telephone and telegraph lines. Among those interested are W. J. Bowie, C. I. Ives, W. R. Hooper, Philip La Montague and W. R. Smedberg, San Francisco.

THE MONTANA ELECTRO-GAS COMPANY, Butte, Mont., has been formed for the purpose of manufacturing and dealing in calcium carbide and liquid acetylene gas for light, power and heat. The promotors are Thomas T. Baker, James H. Monteath, John F. Forbis, Butte, Mont.; Wm. H. Heald, Wilmington, Del.; John S. M. Neill, George F. Cope and A. J. Davidson, Helena, Mont.; Rod D. Leggatt, Butte, and Theo. J. Lynde. Capital stock, $25,000.

THE NEW YORK TRACTION SWITCH COMPANY, New York, N. Y., has been incorporated in West Virginia, for the purpose of dealing in and selling automatic and other electrical railway switches, etc. Those interested are Charles F. Duval, Boston, Mass.; Lorenzo A. Evans, John V. R. Clarkson, and William M. Ryan, New York City. Capital stock, mixmum, $500; maximum, $200,000.

ELECTRIC LIGHT AND POWER.

SALISBURY, N. C.—An electric light plant is to be erected here.

DYERSVILLE, IA.—An electric light plant is to be built at this place.

MANSFIELD, O.—The Council is agitating the question of a municipal lighting plant.

PORT GIBSON, MISS.—An electric light plant is to be erected. Address C. H. Gordon.

CANTON, MISS.—A new electric light plant in connection with the waterworks is being bulit.

MOHAWK, N. Y.—The taxpayers have voted in favor of municipal ownership of an electric light plant.

DUBLIN, GA.—The site for the water works and the electric plant will be placed probably near the river.

STUART, IA.—The municipal authorities have in contemplation some improvements in the electric light plant.

HOLYOKE, MASS.—The Committee on street lights met and voted to ask the Council for an appropriation of $40,000.

EMMETSBURG, IA.—The Emmetsburg people will be given an opportunity to vote a franchise for electric lights at the city election.

WESTON, O.—An ordinance has been passed by the Council granting to Oswald Brothers a franchise for an electric lighting plant.

BEATRICE, NEB.—An ordinance is before the Council to provide for the issue of $10,000 in bonds, for the erection of a lighting plant.

MT. PULASKI, ILL.—A municipal plant is to be installed at this place F. E. Danner is chairman of the Electric Light Committee.

NEW CASTLE, COL.—The Electric Light Committee of the City Council has advertised for bids for an electric light and power plant.

DEFIANCE, O.—The citizens will vote at the Spring election on the question of issuing $30,000 in bonds to establish a municipal lighting plant.

PALESTINE, TEX.—The City Attorney has been instructed to prepare an ordinance to cover the issuance of water and electric light bonds.

BELLEVUE, MICH.—Bellevue is discussing the advisability of putting in an electric light system, and estimates on the cost are being secured.

LOCKPORT, N. Y.—The Lockport Council has passed a resolution appropriating $40,000 for the purchase of a municipal electric light plant.

SOUTH EASTON, PA.—An application was presented by the Easton Power Company, for permission to extend its incandescent lighting plant.

NORFOLK, VA.—Petition of Citizens' Light, Heat & Power Company as to erecting three new poles on the streets, referred to Street Committee.

CONEMAUGH, PA.—It is proposed to borrow $10,000 to be used in the erection of an electric light plant to furnish current for street and house lights.

HART, MICH.—A mass meeting was held recently to consider the advisability of bonding the village to construct a new water-works and electric light plant.

ROCKWELL CITY, IA.—A franchise is to be granted to the Rockwell City Electric Light & Power Company to erect and maintain an electric light plant.

ELIZABETHTOWN, PA.—Mr. Isaac W. Hoffman has purchased the assets of the Elizabethtown Electric Light Company for $7300, subject to a mortgage of $15,000.

LYNCHBURG, O.—The Council has ordered plans to be prepared for a water and light plant; $12,000 worth of electric light and water bonds will be offered for sale.

FLORA DALE, PA.—The Susquehanna Fertilizer Company, of Flora Dale, would like some information on the subject of private plant for generating electricity.

WESSON, MISS.—Messrs. King and Price are putting a 250-light machine in their drug store building, and will supply lights to other merchants on the same block.

PORT JEFFERSON, L. I., N. Y.—The Port Jefferson Electric Light Company has purchased a lot on Water Street, and will erect a brick building for a power house.

CHICAGO, ILL.—A report is expected soon on City Electrician Barrett's plan for increasing pressure in outlying water mains by using electric pumps in eight stations.

BELLEVUE, KY.—Sealed proposals will be received by the village board until Feb. 27, for the lighting with arc lamps of the streets of the town, for a period of one year.

DUQUESNE, PA.—The Carnegie Company is putting in an immense electric plant, not only to light its works, but also to furnish electric power for operating machinery.

DE WITT, IA.—A company has been formed to put in an electric lighting plant, and will be known as the De Witt Electric Light & Power Company. The capital stock is $6,000.

CLEVELAND, O.—The County Commissioners intend to establish an electric plant to light the court house. They will put in the plant just as soon as they can arrange the boilers.

NEW ORLEANS, LA.—The Edison Electric Company has increased its power plant by the addition of a 300-hp Ball engine, manufactured by the Ball Engine Company, of Erie, Pa.

GRAND RAPIDS, MICH.—The city has voted to own its own lighting plant, and has advertised for proposals for $150,000 in bonds. The vote by which the measure was carried was 14 to 9.

SANTA CRUZ, CAL.—The capital stock for the new power company which is to utilize the water of Big Creek for the purpose of furnishing power for an electric plant and railway has all been subscribed.

LAWRENCEBURG, KY.—The City Council has appointed Messrs. John Williams and George W. Hutcheson a committee to make arrangements for the establishing of an electric light plant at this place.

BLOOMINGTON, ILL.—The First National Bank directors are considering putting in an electrical plant to run their elevator, and possibly to light the building. The work will not be performed before summer.

ANTWERP, N. Y.—The question of entering into a 10 years' contract for electric lights for the streets at a cost not to exceed $1000 per year, is to be submitted to the taxpayers at a special election to be called soon.

MARYVILLE, O.—The directors of the Maryville Electric Light & Power Company have decided to put in a new steam plant, and add whatever machinery is needed to the electrical department, to make it of sufficient capacity.

FAIRGROVE, MICH.—Fairgrove is to have electric lights. The plant will be owned and operated by McLuney Bros., grain buyers, of that town. A street car will also be run from the Fairgrove Hotel, to the railroad depot, by electric power.

EAST ORANGE, N. J.—The Suburban Electric Light & Power Company has been absorbed by the People's Electric Light & Power Company of

Newark. This gives the latter company the control of all the electric lighting plants in the county.

LOWELL, MICH.—The contract for electrical apparatus for the city plant was awarded to the Westinghouse Electric & Manufacturing Company. The plant includes a 90-kw multiphase generator, and one 75-light direct current arc machine.

PITTSBURG, PA.—A complete electric light plant has been installed in the handsome building of the Duquesne Club. Westinghouse dynamos direct-connected with Ball engines built by the Ball Engine Company of Erie, Pa., will furnish light and power.

INDEPENDENCE, MO.—The action of the City Council in preparing to buy towers for lighting the streets is meeting with approval by all citizens. The Light Committee suggests the buying of seven more towers, three to be 90 feet high, and four to be 70 feet high.

HULMEVILLE, PA.—At a meeting of Hulmeville Borough Council a committee consisting of Messrs. Afferbach and Reetz was appointed to investigate the merits and costs of a new system of lighting the streets of the town and to report at a future meeting of Council.

CHICAGO, ILL.—City Electrician Barrett has reported to Commissioner Kent on the feasibility of turning eleven bridges by electricity and using the same plant to furnish current for the incandescent lights in the City Hall. He figures the cost of installing the necessary apparatus at $86,663.67 and the annual cost of operating at $32,776.35.

ALTA, IA.—Bids will be received by C. E. Cameron, chairman of the Town Electric Light Committee, up to the evening of Feb. 26, for the erection of an electric light plant. Bids will be received on four separate propositions, one including the electrical equipment, another the construction, a third the boilers, heaters and pumps, and the fourth the engines.

PHILADELPHIA, PA.—The Councils Committee on Fairmount Park and the committee on superintendence and police of the Park Commission, have adopted a resolution authorizing the re-advertisement of bids for lighting the park, with a proviso that no bids will be received at a price greater than the average price paid by the city for lights in the immediate vicinity of the park.

DECORAH, IA.—A proposition has been made to the City Council, to erect a first-class electric lighting plant, if a franchise is granted for a term of 20 years. The franchise cannot be granted by the Council, however, until it has been submitted to the voters of the city and carried by a two thirds vote. The matter will be thoroughly discussed and measures taken to submit the question at the election on March 3.

MT. PLEASANT, IA.—The present contract with the Gas & Electric Light Company will expire in the Spring, and the committee has reported in favor of the ownership of the plant by the city. The company holding the present contract made an offer to light the city with 65 800-cp arc lights, to burn till midnight, 17 nights in the month, for $2,500 per year. The City Council has asked the people to authorize it to erect and maintain a plant to be owned by the city.

HARTFORD, CONN.—The Hartford Electric Light Company will in a few months substitute very largely, if not entirely, water-power for steam in the generation of electricity. For this purpose its dam near Rainbow will be raised about five feet, which will enable the company to supply about 30 per cent. more power than it can at present. In addition it proposes to build a dam 26 feet high at the foot of the gorge of the Farmington River above Tariffville, which will render available about 1500 horse-power.

DETROIT, MICH.—The Schilling Corset Company is equipping its factory with the latest improved electrical appliances. The installation will include a complete signal and telephone system, and a 70-kw generator, 14 1 and 2-kw motors, and 500 16-cp lamps. Motors will be used principally for running sewing machines. They will be attached by gears, to the centre of line shaft, one motor for each table of about 20 machines. The Fontain Crossing & Electric Company is putting in the electrical machinery, and the wiring will be done by the American Electric Company, of Detroit. Humphrey & Carr, of Detroit, are doing the engineering.

THE ELECTRIC RAILWAY.

PITTSTON, PA.—Pittston is to have a new street railway.

YORKVILLE, S. C.—It is probable that a railway will soon be built from Blacksburg to Spartanburg.

CALDWELL, N. J.—The North Jersey Traction Company is seeking to obtain a franchise to operate a trolley road in this town.

NILES, O.—Daniel Monahan, owner of the Mineral Ridge & Niles Electric Street Railway, is going to extend his line to Youngstown.

NEW BRUNSWICK, N. J.—The directors of the Consolidated Traction Company have decided to lay another track between this city and Milltown.

NEW BEDFORD, MASS.—Proposals are called for building the four miles and a half of railway between the new pumping station and Braley's.

POTTSTOWN, PA.—Work on the proposed electric railway between this place and West Chester will probably be commenced in a short time. The right of way has been secured.

LOWELL, MASS.—The petition for the extension of the street railway system through Centralville hill, is being seriously considered by the Lowell & Suburban Street Railway Company.

BOSTON, MASS.—James R. Kendrick, the third vice-president of the New York, New Haven & Hartford Railway Company, says that the road will equip the Dedham Branch with electricity some time in the coming Summer.

SHEBOYGAN, MICH.—George Silsby, head of the rapid transit electric line between Bay City and Saginaw, is here looking over the street railroad line, with the view to making it an electric line and extending it to inland lakes.

THOMPSONVILLE, CONN.—The plan for an extension of the Thompsonville & Enfield Street Railway through Enfield and Longmeadow to Springfield, has been revived, and a petition has been sent to the Massachusetts legislature.

DOVER, DEL.—There seems to be little prospect of the Dover & Milford Electric Railway being built. The Philadelphians who are interested in the matter want the people of Kent County to raise $50,000 of the amount necessary to build the road.

TAUNTON, MASS.—There is a petition before the Legislature for the incorporation of the Barnstable County Street Railway Company, to run in all towns where they can receive a location, and to receive a 60-foot location over private grounds where necessary.

PORTLAND, CONN.—At a town meeting plans were approved for the extension of the Middletown Street Railway to Gildersleeve Landing, whence it will be extended to South Glastonbury, thus indirectly paralleling the New Haven Electric Railway on the other side of the river.

NEW BRIGHTON, S. I., N. Y.—A hearing upon the application of the Staten Island Electric Railway Company, for permission to build and operate an electric road along Richmond Turnpike from Bull's Head to Linoleumville, will be given soon by John W. Lisk, Highway Commissioner.

KENOSHA, WIS.—The promoters of the Milwaukee, Racine & Kenosha Electric Railway appeared before the Common Council and presented a petition for a new franchise for the privilege of running cars through Kenosha, to build and operate three miles of electric road in the city.

PORT CHESTER, N. Y.—The Port Chester Board of Trustees have received an application from the Port Chester Electric Railway Company for a franchise to build a trolley road. The Port Chester, Rye, Harrison & Mamaroneck Railway Company also applied for a similar franchise.

READING, PA.—Negotiations are now pending whereby there will be a continuous line of electric railway from Reading to Lebanon, 28 miles. At present, one road extends from Reading as far as Womelsdorf, and another from Lebanon to Myerstown, leaving only about six miles to build.

NEW BRITAIN, CONN.—A hearing will be held to consider the request of the street company for permission to run its lines through certain streets in order that it may run their cars to the Newington town line to connect with the Newington Traction Company's tracks and thence to Hartford.

ELYRIA, O.—The local capitalists are said to be investing in bonds of the proposed electric railway to Elyria, North Amherst and Oberlin. One hundred and twenty-five thousand dollars worth of the issue has already been bargained for. Contracts for some of the material have already been entered into.

MINNEAPOLIS, MINN.—The Minneapolis & St. Louis Railway Company is planning to operate its line between Minneapolis and Lake Minnetonka by electricity. Power houses will be erected at each terminal, and will furnish current also to charge accumulators for running a fleet of naphtha yachts.

BALLSTON SPA, N.Y.—The Highway Commissioners of Milton have granted a franchise to Arthur B. Paine, of Philadelphia, to build an electric railway from Ballston Spa to Rock City Falls. The road is to be known as the Ballston Spa Terminal Railway, and work will be commenced on it within a month.

BOSTON, MASS.—There has been filed in the clerk's office of the Massachusetts House of Representatives, a petition signed by George A. Lancaster, praying for an act to permit him and his associates to build an elevated railway in this city. The bill asks for the creation of a corporation, to be known as the Lancaster Elevated Railway Company.

AURORA, ILL.—Among the licenses issued by the Secretary of State to corporations, was one increasing the capital stock of the Carpentersville, Elgin & Aurora Railway Company, of Elgin, from $50,000 to $150,000. The original capital stock was used up in building the Elgin-Dundee road, and the increase is in a line with a movement to raise sufficient funds to build the Elgin-Aurora connection.

WATERTOWN, MASS.—A hearing has been given by the Selectmen on the petition for a franchise to operate an electric railway between Watertown and Belmont, running through certain streets of the former city. There is much opposition to the proposed railway, and a petition objecting to the grant of the franchise has been circulated among the citizens. The matter has been taken under advisement by the Selectmen.

Business Notice.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

Trade and Industrial Notes.

I. P. FRINK, 551 Pearl Street, New York, has just finished equipping the art gallery of Mrs. Potter Palmer, of Chicago, Ill., with reflectors especially designed for the purpose. The results, it is said, have been highly satisfactory.

WM. H. WESTON & CO., manufacturing electricians, 1305 and 1307 Buttonwood Street, Philadelphia, are preparing for distribution a new catalogue, which will be ready in about a month, and will contain matter of interest to those identified with the electrical business.

THE FOSTER ENGINEERING COMPANY, of Newark, N. J., has just received a large order from England for valves, ranging in size from ¾ inch to 10 inches. It has also recently shipped 25 of its air brake pump governors to Vienna, and made a further large shipment of valves to Bremen.

MR. R. A. HUMPHREYS, 1022 Ridge Avenue, Philadelphia, Pa., is largely extending his business with street railways all over the country, his specialties being a patent oiled duck used for covering motors, awning stripes for car curtains, and cotton duck for car tops; in addition he builds and repairs cars.

FILES.—Those of our readers who are not sure in regard to what the various names given files exactly signify with respect to the cuts will do well to send

to the G. & H. Barnett Company, Black Diamond File Works, Philadelphia, Pa., for a circular in which this is made plain by a number of illustrations. Eighteen illustrations are given, which clearly distinguish between all of the various cuts of files, from rough to rasp.

THE DETROIT ELECTRICAL WORKS will be offered for sale at public auction on March 4, at the office of the trustees of the property, Messrs. Louis Warfield and William A. Jackson, Detroit, Mich. The assets will be offered in two schedules, one comprising the manufacturing plant, material and patents and another the bills and accounts receivable, stocks, bonds, claims, etc. Several alternative conditions of sale are offered.

PRACTICAL INFORMATION ABOUT INJECTORS.—The Hayden & Drew Manufacturing Company, 111 Liberty Street, New York, has issued the second edition of its pamphlet with the above title, which, it may be added, well represents the character of a great deal of the matter contained. Suggestions are given as to the proper type of injector to select for a specific case, as well as directions for connecting and practical hints for operating.

THE HARRISON SAFETY BOILER COMPANY, Philadelphia, has been awarded the contract for feed-water heaters and purifiers for the Columbia & Maryland Railway, the Cochrane type of apparatus being specified. This is the new electric line between Washington and Baltimore, now in the course of construction, with power-houses at Ilchester and Paint Branch of 3000 hp each. The advisory engineer of this company is Prof. R. C. Carpenter, of Cornell University.

ALTERNATING-CURRENT CEILING FANS.—The Tuerk Water Meter Company, Fulton, N. Y., in a handsome catalogue, describes the Tuerk electric ceiling fans, and introduces to the trade a new alternating-current fan. This latter has neither brushes nor commutator, and may be run on any simple alternating circuit system. The bearings are self-oiling, it being necessary to oil them but once in a season. Both alternating and direct-current ceiling fans are made in very handsome designs, and are finished in several different styles.

THE LINK-BELT MACHINERY COMPANY, in its new "Catalogue No. 20," describes and illustrates in detail the numerous forms of apparatus which it manufactures for carrying out modern methods of handling and mining coal, etc. Among the machinery made is a complete equipment for electric coal mining, consisting of generator, electric locomotive and electric drills, electric mine pump, arc lamp, electric grinder, etc. The "Monobar" conveyor is illustrated in much detail, as are a number of other forms of conveyor chains.

RULES.—Darling, Brown & Sharp, Providence, R. I., have issued a catalogue devoted entirely to the subject of scale rules. From the introduction we learn that the manufacture of these rules was begun in 1850, by Mr. Joseph R. Brown, and by Samuel Darling in 1850, the present firm having been formed in 1866. In addition to the lines of metal rules made by this firm during almost half a century, another of tempered rules has been recently introduced, which by means of machinery specially adapted for this purpose, are as accurately graduated as the widely known standard and soft rules of this firm.

SILK WASTE MACHINE WIPERS.—That silk waste may be used about machinery and at a saving in cost over cotton waste, at first sight may seem remarkable, but it is claimed, nevertheless, to be true. Silk waste such as that made by the American Silk Manufacturing Company, 311 Walnut Street, Philadelphia, Pa., not only thoroughly cleans the machinery on which it is used, but leaves no small fibres or threads behind; moreover, by means of a special washing compound, the wipers can be employed over again as many as from eight to twelve times. Still another advantage is that silk waste is entirely free from the danger of spontaneous combustion.

FLUORESCING SALTS FOR ROENTGEN RAY EXPERIMENTS.—The universal interest displayed by physicists in Roentgen's recent discovery has developed an unprecedented demand for the salts of platinum which fluoresce under the impact of the new rays. Messrs. Baker & Co., the platinum refiners of Newark, N. J., inform us that they have sold more of the particular salt recommended by Roentgen as most suitable for experiments, with the rays bearing his name, namely, barium platino cyanide—than ever before in the history of their business, and that in consequence of the undiminshed demand for the salt they have been obliged to increase their laboratory force.

THE CUTTER ELECTRICAL & MANUFACTURING COMPANY, 1112 Sansom Street, Philadelphia, announces that the assignment made in August last has been dissolved, and with largely increased capital it will continue its business as heretofore. The company will devote special attention to the manufacture of its C. S. flush switches and I. T. automatic magnetic circuit-breakers. The demand for circuit-breakers is already taxing the present capacity of its factories. This enterprising firm is to be congratulated upon the rapid and very creditable manner in which it overcame its recent business difficulties, and enters upon its new career with prospects heightened through the high respect its conduct has given rise to.

THE GRAHAM EQUIPMENT COMPANY, of Boston, Mass., is preparing to ship to Paris, France, six steel I-beam trucks, ordered by M. Le Blanc, the French engineer, when he was here in America investigating the different trucks and service. These trucks are to be placed upon the Traction Electrique Line in Paris, and were ordered because M. Le Blanc concluded after investigation that they are the lightest, simplest and strongest, as well as the only entirely spring-suspended trucks in America. Further, M. Le Blanc required a truck with powerful breaks, and the Graham equalized brake possesses the strongest features, as it will enable the Traction Company to dispense with inside brakes and truck, therefore greatly simplifying the equipment.

THE UNITED STATES TELEPHONE CONSTRUCTION COMPANY, of Philadelphia, have moved its offices from the Bullist Building to very handsome quarters in the Philadelphia Bourse. It has also largely increased its capital and is going into the telephone business on a much larger scale than heretofore, the plan being to organize State or sub-companies to cover the entire United States, and allow these companies to manufacture their own instruments when desired, thus giving each sub-company all the manufacturing profit and an opportunity to meet all local requirements. If the Berliner patent is sustained by the United States Supreme Court, this company, owning and controlling the *Method Patent* for a make-and-break telephone, claims that it will be practically the only opposition the Bell Company will have. It will make five styles of telephones, and give non-infringing guarantees. Its new long-distance telephone is guaranteed to talk over 5000 miles of resistance.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED FEB. 11, 1896.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

554,656. TELEPHONE; F. R. Colvin, New York, N. Y. App. filed Nov. 24, 1894. In a party telephone line, the combination with a plurality of sub-stations, of a metallic circuit, the two limbs of which extend through all of the said sub-stations, a normally open bridge at each of said sub-stations, a microphone or battery transmitter directly included in each of said bridges, a battery connected in circuit at each sub-station, means at each sub-station for closing the bridge, whereby two telephone sets may be looped into circuit for conversation, a signal transmitting instrument at each sub-station, located in a branch extending from one of the metallic limbs to ground, and a signal receiving instrument at each sub-station located in a branch extending from said metallic limb to ground.

554,664. MEANS FOR SUPPORTING AND INSULATING ELECTRIC CONDUCTORS; T. T. Eckert, New York, N. Y. App. filed Dec. 8, 1894. In an insulating support for electric conductors the combination of a metallic pin with a cap of wood, paper or other insulating material, the wood being covered with a casing of insulating substance.

554,665. GAS LIGHTING SAFETY APPLIANCE; F. and F. H. Engelhard, Springfield, Mass. App. filed June 3, 1895. The combination of a source of electrical energy, a spark coil connected thereto, a gas jet, sparking points adjacent to said gas jet, and electrically connected to said spark coil, a clock mechanism and a make-and-break mechanism operated by the escapement of said clock mechanism, and adapted to make and break the circuit connecting said electrical source and the spark coil.

554,670. INDUCTION MACHINE; W. K. Freeman, Fort Wayne, Ind. App. filed July 5, 1895. In an induction machine, the combination with a base and the cheek pieces projecting upwardly therefrom, of movable field pieces secured between said cheek pieces and the armature journaled between the movable field pieces.

554,671. HEAT REGULATOR; E. Frischnecht, New York, N. Y. App. filed March 9, 1895. A thermal circuit-closer for heat regulators and other purposes, consisting of a movable contact, a spiral, an index carrying the same, an adjustable contact having conducting and insulating parts, guides for the latter contact, and a scale.

554,694. TROLLEY SUPPORT; F. E. Homer, Cleveland, O. App. filed Nov. 30, 1894. In a suspended trolley pole support, the combination of a sleeve-socket, a base frame, equalizing chain loops secured at their extremities to the upper and lower portions of the socket, and coiled springs secured at their outer ends to the base plate, and at their inner extremities to said chain loops.

554,697. LIGHTING CARS; W. F. Hutchinson, New York, N. Y. The combination with the car and a revoluble screw on the car track of a generator on the car, and a train of gearing connecting the generator with the screw.

554,716. ELECTRICAL CONNECTING CORD; C. H. McEvoy, Lowell, Mass. App. filed May 15, 1895. An electrical connecting cord comprising two covered conductors enclosed in a common covering and projecting from the ends thereof, and one or more suspension cords arranged in said covering, the ends of said covering being turned in.

554,719. CONDUIT ELECTRIC RAILWAY; W. Oesterlein, Cincinnati, O. App. filed Sept. 21, 1894. A support for electric conductors, embodying a support stem, a cup-shaped stand carrying the stem in suitable insulation, and one or more shields surrounding the stem and covering the mouth of the stand.

554,723. INSULATOR; E. Peloubet, Alexander, Ark. App. filed Nov. 1, 1895. An insulator comprising a base of metal with openings therethrough, one of which has a communicating slot, and glass insulators in said openings.

554,759. ELECTRIC BATTERY; C. Willms, Baltimore, Md. App. filed May 3, 1893. The combination with a cell support of a battery cell, having enlarged cell-supporting terminals, bent outward at their outer ends.

554,760. ELECTRIC BATTERY; C. Willms, Baltimore, Md. App. filed Jan. 19, 1894. The combination with a cell of a cell case having a cell space larger than the cell, a removable non-conducting cap on said cell case through which the terminals pass, and rubber sleeves on said terminals inside the cap.

554,761. ELECTRIC BATTERY AND METHOD OF SEALING BATTERY CELLS; C. Willms, Baltimore, Md. App. filed July 12, 1894. A sealed battery cell having outside the battery fluid a plug of viscous material, a supporting plug outside of and resting upon said viscous plug and a sealing plug of plastic material that expands on setting outside of and upon said supporting plug.

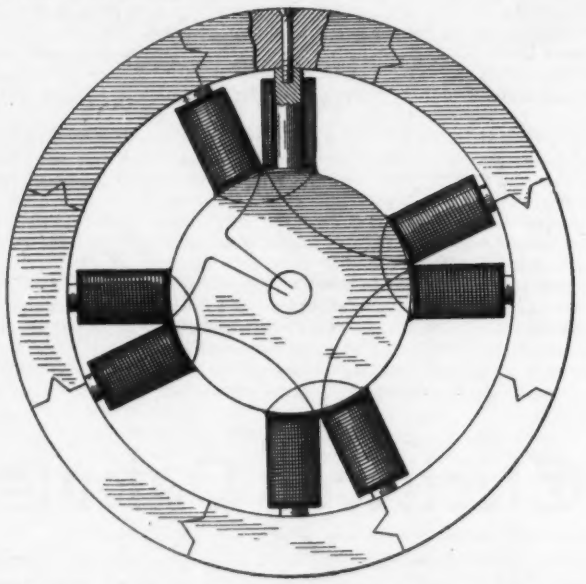
554,821. ELECTROMAGNET; J. Houlehan, Chicago, Ill. App. filed May 10, 1895. An electromagnet comprising a set of wire-wound soft-iron cores, and pole-pieces successively of opposite polarities at the outer ends of said cores, said pole-pieces comprising segments joined together end to end and forming an annulus, said segments being composed alternately of soft iron and non-magnetic solid material. (See Illustration.)

554,859. RAIL BOND FOR ELECTRIC RAILWAYS; R. C. Brown, Somerville, Mass. App. filed March 21, 1894. The combination with the rails of an electric railway of a rail bond comprising a hollow plug inserted through each of the rails to be connected, and a tie wire extending through said hollow plugs and joining together at its ends.

554,862. MEANS FOR RECORDING AND REPRODUCING IMPULSES; W. H. Cooley, Brockport, N. Y. App. filed April 16, 1889. In combination with a recording surface having a record thereon, changing in conductivity along the line or surface of such record, means for passing an electric current transversely through such record surface at successive points therein, longitudinally of such record, and thereby opposing to such electric current-varying resistances, by varying the length of the path traversed by such electric current through a resisting medium.

554,868. ELECTRICALLY OPERATED RAILWAY TRACK SWITCH; F. H. Harriman, Hartford, Conn. App. filed Dec. 11, 1895. In combination, a reversible trolley pole, shafts carried thereon, a pinion, a gear-sector connected to a crank arm and crank pin, and a slotted crank arm carried on the shaft.

554,884. MANUALLY CONTROLLED ELECTRIC BLOCK SIGNAL SYSTEM; A. G. Leonard, New York, N. Y. App. filed July 26, 1894. A signaling instrument comprising a rocking spindle, means for locking it and releasing it at suitable intervals, a plunger, a circuit closer, and a swinging bar or plate under the control of the rocking spindle to prevent or permit the action of the plunger.



No. 554,962.—Electromagnetic Induction System of Propulsion.

554,889. FIRE ALARM TELEGRAPH SYSTEM; J. F. Mehren, Chicago, Ill. App. filed April 4, 1894. In a signaling system having two independent main lines over each of which every signal is transmitted successively first over the one and then over the other line, the combination with two signal-receiving instruments each connected in one of the said main lines and respectively responsive to the said successively transmitted signal of an alarming device normally operative by one of the said receiving instruments and controllably connected for its operation with the other said receiving instrument.

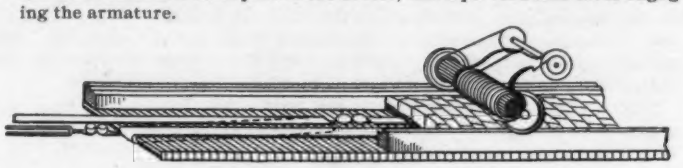
554,895. TELEPHONE; W. H. & G. E. Russel, Little Falls, N. Y. App. filed Aug. 10, 1895. A transmitting telephone having a resonant case, two vibrator diaphragms, mounted in the ends of said case, a cylinder extending centrally within said case, two cup-like carbons positioned within said cylinder, and having their disc-like bottoms arranged face to face, granulated carbon between said bottoms, a bar connecting each vibrator diaphragm rigidly with a carbon cup and means for regulating the compression on the granulated carbon between the cups.

4,896. KEY SOCKET FOR INCANDESCENT LAMPS; B. W. Snow, Syracuse, N. Y. App. filed Jan. 2, 1895. The combination of an insulative base, an insulated stop supported thereon, a terminal secured to the base, a second terminal secured to the stop, a revoluble key journaled intermediate of the base and stop and provided with an angular block having pressure surfaces, each provided with a groove transverse the direction of revolution of said block, and a contact spring having one extremity secured to the stop and in electrical connection with the second terminal, said spring extending freely over and around three sides of the block in the path and place of the path thereof, whereby the spring may be depressed and caused to make a rearward sliding contact with the first terminal when operated upon by the block, and may then return slightly and rise into a groove of the block to retain the latter in its operative position.

554,910. ELECTRIC HEATER, RESISTANCE, OR RHEOSTAT; P. B. Delany, South Orange, N. J. App. filed June 7, 1892. An electric heater or resistance consisting of a conductor or conductors having fire-proof insulating buttons strung thereon in contact and constituting a continuous flexible insulation embedded or enclosed in a mass or block of refractory insulating material.

554,914. ORE CONCENTRATOR; J. O. Dimmick and E. K. Woods, Denver, Col. App. filed April 27, 1895. In an ore concentrator, a pair of inclined tables each comprising a metal bed-plate, a bed of insulating material over the metal bed and rows of metallic pins extending from the metal bed through the bed of insulating material, and an electromagnet having one pole connected to the metal bed-plate of one table and the other pole to the metal bed-plate of the other table.

554,918. ELECTRIC CIRCUIT CLOSER AND BREAKER; J. R. Farmer, St. Louis, Mo. App. filed May 25, 1894. In a circuit closer the combination of an electromagnet, an armature hinged to one end of the magnet and extending along to the opposite end thereof, contacts mounted on the armature and on a fixed part of the device, and a pivoted cam-lever engaging the armature.



No. 554,821.—Electromagnet.

554,949. RAIL BOND FOR ELECTRIC RAILWAYS; S. Nikoloff, Worcester Mass. App. filed Jan. 2. 1896. An attaching device or plug for electric rail bonds, comprising an outer cylinder joined at one end with an inner cylinder axially concentric and parallel therewith, and having an annular intervening space for the reception of a tubular key or expander.

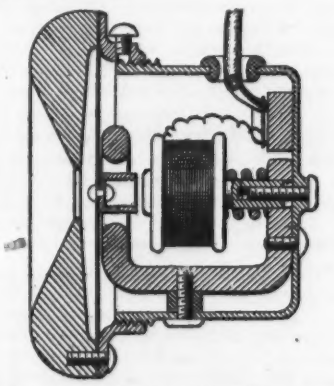
554,955. INSULATOR FOR ELECTRIC WIRES; M. Rieta, Havana, Cuba. App. filed Sept. 5, 1895. An insulator for electric wires comprising two clamp members, one L-shaped and the other an inverted L-shape so as to enclose between them a substantially prismatical space, and an elastic filling held in the said space, and apertured for the reception of the wire.

554,957. SAFETY SYSTEM FOR RAILWAYS; B. C. Rowell, Boston, Mass. App. filed Sept. 4, 1894. In a railway block system the combination of a plurality of blocking apparatuses, a locking bolt for each blocking apparatuses. a single locking bar provided with a plurality of bolt holes corresponding in number to the bolts, a hand lever for moving each bolt and its blocking apparatus, and a hand lever for moving the locking bar to bring any bolt hole back in line with its bolt.

554,962. ELECTROMAGNETIC INDUCTION SYSTEM OF PROPULSION; A. C. Shuttleworth, Philadelphia, Pa. App. filed Feb. 7, 1895. In a system of distribution of electrical energy for railways, the combination with sections of laminated iron ties, of a single insulated primary conductor wound around and at right angles above and below the sections of laminated ties in a series of single convolutions or spirals, said laminated ties forming stationary parts of a magnetic circuit, a movable part of the magnetic circuit, a secondary electric circuit encircling the movable part of the magnetic circuit, and automatic switches for producing a multiple or parallel arrangement of the upper and lower sections of the primary conductor when said switches are in their normal positions. (See Illustration.)

555,056. GALVANIC BATTERY; E. L. Slocum, Pawtucket, R. I. App. filed July 2, 1894. In a galvanic battery, the combination of an insulator provided with a central opening with a plurality of positive electrodes arranged around the said opening, and a well for quicksilver at the bottom of the jar, under the said opening in the insulator.

555,051. TELEPHONE INSTRUMENT; H. P. Pratt and H. A. Allen, Chicago, Ill. App. filed Feb. 19, 1895. A telephone instrument comprising a bent magnet having an annular pole-piece on one end and a pole-piece provided with a helix and arranged at its opposite end, and a diaphragm provided with an armature arranged to extend through the space within the annular pole-piece. (See Illustration.)



No. 555,051.—Telephone Instrument.

555,057. ELECTRIC LIGHTING SYSTEM; E. L. Slocum, Pawtucket, R. I. App. filed April 3, 1893. The combination of electric batteries arranged for connection with a lamp circuit and separate electrical connections with the negative pole with each of the several batteries, which connections do not extend to the positive electrodes of the batteries with an automatic commutator adapted to distribute the electric current through the said separate connections to a pluralities of said batteries and to effect the disengagement of one of the plurality of engaged batteries for recuperative rest, and the engagements of the recuperative battery in its stead, and the hand switch for directing the electric current to the lamps.

555,058. GALVANIC BATTERY; E. L. Slocum, Pawtucket, R. I. App. filed March 28, 1893. The combination with the carbon electrode having a central cavity and longitudinal ribs, extending inwardly of the supplementary carbon electrode held within said cavity.